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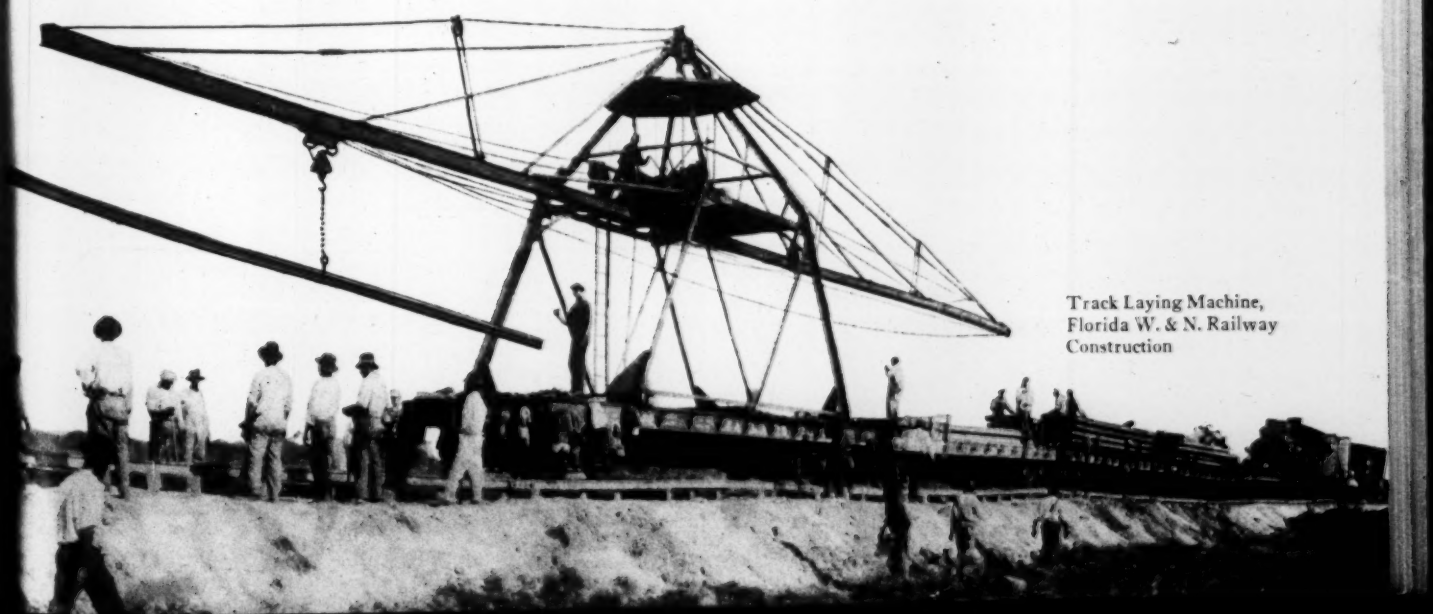

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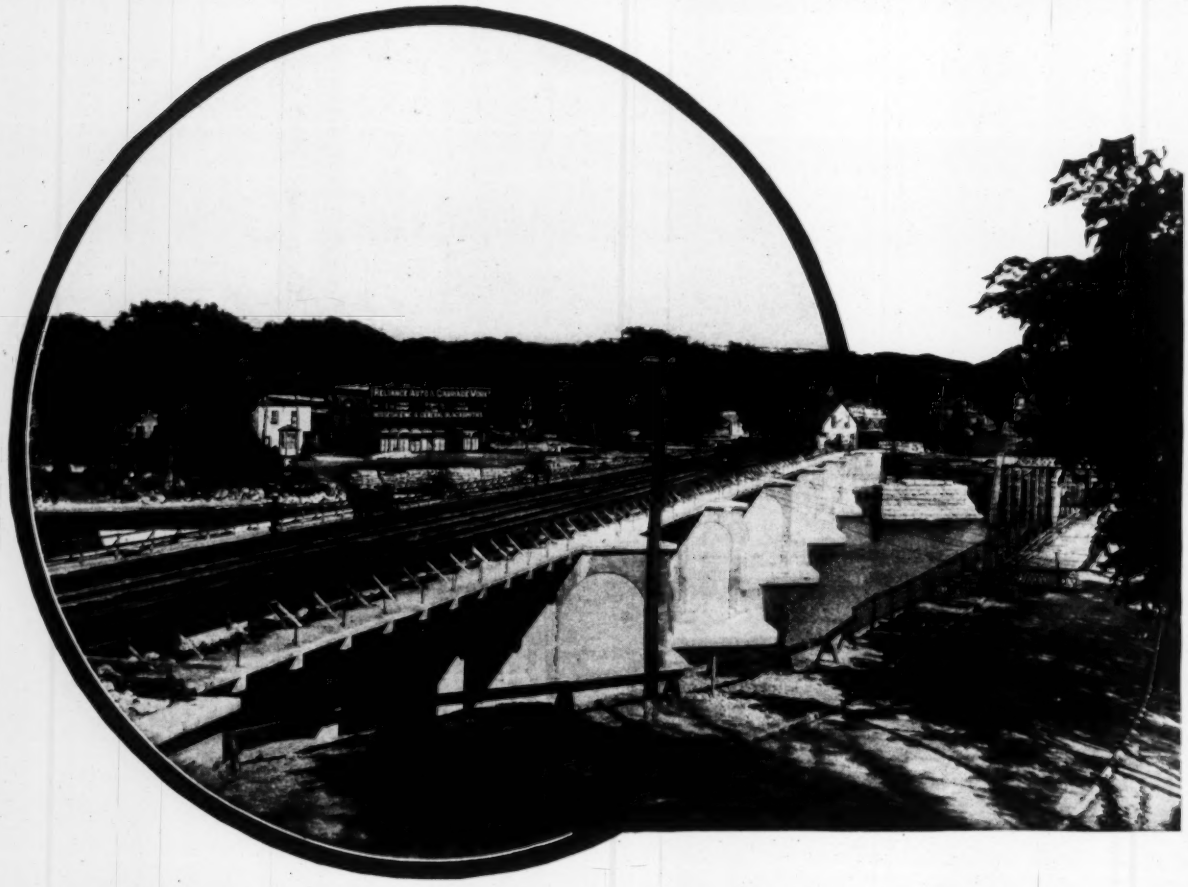

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 94 NEW YORK, JUNE 4, 1925 Number 23

What's in a Name?

IN AN altogether praiseworthy effort to establish a distinction where there is a difference the United States Civil Service Commission has designated as "engineman" the person who operates a stationary or moving engine and has reserved "engineer" to those "with a technical training." This is one step toward the proper definition of the word "engineer," and it is about all such government bodies can do, but after all it attacks only a minor form of the evil. The name "engineer" has been applied to the man who operates an engine ever since there were engineers in the world or in the language, but the men who do such work and bear this name for doing it are not the ones who are detracting from the dignity that attaches to the name when it concerns the technical engineer—the man who applies the forces of nature to the use and convenience of mankind. It is the pseudo-engineers who need chastisement—the quacks and the pretenders, and all those who either steal a worthy title to indicate a scientific method in their own non-engineering business or those who with a trace of engineering elementals pretend to a possession of the complete art. How to reach such misuse is another and a much more difficult problem.

Encouragement for Trade Associations

THE Supreme Court decision on trade associations will materially affect the conduct of such associations and the conditions of competition in industries. Evidently the majority of the Court take a liberal view of what constitutes unlawful competition. They are coming to believe that a proper knowledge of the conditions of production, cost and consumption throughout the trade is a fundamental to a proper and safe conduct of the individual business in that trade. The decision does not encourage a return to monopoly or trust conditions, where prices are controlled to the detriment of the customer; that will of course continue to be unlawful. It does remove the taint of guilt from the honest effort to acquire enough fundamental data of an industry to permit all in it to conduct their business sanely and profitably, but with due consideration for the rights of the purchaser. Attorney General Sargent recently suggested that trade associations submit to him the outline of any proposed plan of action, so that at least he might point out wherein such plans might be illegal. This new attitude of the Department of Justice taken with the Supreme Court's latest decision indicate that the trade association has ahead of it a new and larger opportunity as an aid to industry.

Co-ordinating Rail Deliveries

IN BUILDING the Exchequer dam described in our last previous issue, it was possible to find storage for only a day's supply of aggregate and two days' supply of cement. Obviously for a 400,000-cu.yd. structure designed to be concreted at the rate of 50,000 cu.yd. a month during the high level of operations, this condition demanded very precise co-ordination of rail deliveries of concrete materials with the concreting schedule. Virtually, for the construction period, the railway was a unit of the construction plant, and its performance as much a concern of the works manager as that of any unit. Here is a common circumstance of modern construction. In operations of major volume the railway as public carrier is drafted into the construction plant and carries on one process of the operation. On the Exchequer dam, for example, if the railway failed to deliver aggregate for one day output was curtailed as certainly as if the mixers or the chuting systems had broken down for the same period. Railway service is as much a task of construction management at Exchequer as is concrete mixing or distribution. It is so on all construction works which require rail delivery of materials. Generally the large-operation contractor does not overlook this condition or neglect organizing to control it. It is a common oversight and neglect of the smaller operator. He normally is at the mercy of his rail deliveries, and often his subjection is because he is not organized to alter the situation. A good traffic supervisor is as important as a good construction superintendent on any sizeable operation getting its materials by rail.

Separate Sludge Digestion

SEPARATE digestion for the excess sludge produced in the activated-sludge process is the latest claimant for attention in a field that still presents opportunity for research. Dr. Imhoff's studies of this method, carried on in the Ruhr District, Germany, and outlined by him in this issue, are promising. Engineers will await with keen interest the outcome of Dr. Imhoff's large-scale plant in which this method will be embodied. Presumably, we will be hearing of American studies along the same line before many months have passed.

Craftsmanship Still Needed

IT IS no criticism of those pioneer investigators who have been working in the last decade to establish better methods of proportioning concrete to say that their conclusions offer no sovereign remedy for bad concrete. It is almost as easy to make a porous weak concrete out of aggregates proportioned with regard to the last grain size and with water reckoned to the last ounce as it was when proof of a 1:2:4 mix was considered the answer to any criticism of bad concrete. This is the lesson Mr. Young emphasizes in his article in this issue. There is no doubt that there is economy to be had in studying aggregate and proportioning it according to its characteristics. There is certainly an optimum amount of water to be used in every batch. These are the things the new investigations have proved. But with the absolutely correct proportions of all the ingredients, there must be the most careful attention to what might be called the elementals of concrete

making, that is good mixing and careful placing. And further than that, the ascertainable preliminaries of the mix, those that guarantee that certain proportions will bring certain results, depend entirely on that quality of the concrete which is called variously consistency or workability. The properties of the mixed mass, of constant proportions, vary with this workability, which depends on methods of mixing quite as much as on the materials and their proportions. It is unfortunate, perhaps, that so far we have not been able to reduce the measure of this workability to the same exactness as we have the proportioning. We have certain tests, notably the slump test, but they are by no means certain nor absolutely concordant. The eye of the trained observer remains the best meter. Concrete men will do well to remember this, and not think that their problems are all solved by a table of proportions or by a proper respect for the cement-water ratio. There is still a lot of craftsmanship in making concrete.

No Unit Set Up for Competitive Bids

THE judge who recently held that the 10-year garbage disposal contract award at Kansas City, Mo., is illegal because the specifications failed to set up a standard bidding unit and therefore were "not productive of competitive bidding" may have laid foundations better than he knew. A similar doctrine has been announced elsewhere now and then but not with such frequency and insistence as to put a stop to the plan, censured by the Kansas City judge, under which each contractor virtually makes his own plans and specifications and bids on them, without knowledge of the sort of plant the other bidders would propose to erect. It is high time this sort of thing be stopped. Enlightened public opinion should have done it long ago. Where it is lacking it is to be hoped that there will be more examples of court intervention like that at Kansas City.

What the Lord Has Made

FROM Shelby, Mont., to Dayton, Tenn., and from the manly art of self defense to a religio-legal debate on evolution are far cries. However, the motives of the chief combatants in the two events may compare, the attendant crowds are activated alike by desire for the thrills of a spectacle quite out of the ordinary. The inruption of such multitudes into places of a few hundred inhabitants creates grave sanitary problems, far beyond the usual capacity of the governments of such small communities. What the Montana state authorities did to safeguard the throngs expected at Shelby—for throngs were counted on even if they did not equal expectations—we do not know. Presumably the Tennessee legislature has not yet prohibited state sanitary measures to meet such an emergency as may arise when the young teacher of evolution comes up for trial at Dayton, but it or some other legislature may yet oppose sanitary measures on the same basic ground as did the colored preacher recently at Knoxville, Tenn., when the health department put a ban on the use of water for drinking purposes from limestone springs. This preacher urged that the spring water must be pure because the Lord had made it. The same line of argument directed against sanitary measures during the coming trial at Dayton, Tenn., would be scarcely less reactionary than the law against the teaching of evolution in the State of Tennessee which is the occasion for the trial at Dayton.

More Light on the Contractor

ONE step toward insuring the responsibility of contractors, and of cutting down the number of failures in the contracting business, will be taken if contract-awarding authorities insist on the filling out by bidders — or even by the lowest bidder — of the experience, equipment and financial questionnaires just adopted by the conference of representatives of societies interested in contract bonding. These questionnaires have been carefully worked out by contractors, bankers, surety people, engineers and architects, and are soon to be made available, probably through the Associated General Contractors. Their intent is to present to the awarding body as nearly true a picture as possible of the resources, financial, physical and experiential, of the contractor who proposes to undertake construction work.

The preparation of such a questionnaire may seem to be an academic effort to those authorities who by law are required to award the contract to the lowest responsible bidder, the responsibility by the same law being assured by the fact that the bidder can furnish a corporate bond. It must be remembered, however, that the major purpose of the contract bonding conference, which has prepared the questionnaire, has been to set up some method whereby a better assurance of responsibility of the contractor can be had by both the awarding authority and by the bonding company. Too many irresponsible contractors are being bonded. Some of them are being bonded by irresponsible sureties, but more, we believe, are being bonded by honest intentioned surety companies because those companies have not sufficient information as to the responsibility of the contractor seeking the bond. Insistence by the awarding authority on the questionnaire will have several effects, but they all should tend toward better assurance of the contract being satisfactorily completed.

In some cases the awarding body has discretion as to the award, such as in the State of Ohio where the "lowest and best" bidder may be accepted and where the attorney general has interpreted this to mean that the commissioner of public works can use his own discretion, always supposing that he avoids fraud or collusion. In such cases the questionnaire is of estimable value because it will present to the awarding body or official a true picture of the contractor's adequacy in all ways for the work he is about to undertake. Further than that, it will serve to deter the irresponsible contractor from submitting a bid, because if he feels that his irresponsibility in any of the three particulars which are being investigated is a matter of information available to those who are to award the contract, he will be reluctant to attempt to get the job.

Finally, the bonding companies themselves will either directly, if the contractor chooses to submit the information to them, or indirectly, if the awarding body chooses to use the information available in the questionnaires, be advised of the potential irresponsibility of bidders and will therefore be in possession of much more information on which to judge whether a bond should or should not be issued. It will indeed be a most healthy thing for a public awarding body to be able to confront a bonding company about to bond an obviously irresponsible contractor with facts as to that irresponsibility which would require some explanation. The elimination of the irresponsible surety company should be materially helped.

It is possible, of course, that a contractor will be able to judge his report, that he will be able to make a better presentation in the blank than his condition warrants. It is also true that no paper presentation of a contractor's responsibility will guarantee his successful completion of work, but nevertheless the more those interested know about the man who is about to undertake a large public construction, the better they are able to judge the desirability of letting him attempt it and the more definite will become the legal interpretation of the word responsible as applied to a bidder.

Study of the Flood Risk

PROGRESS is being made in the study of the flood hazard. The latest instance is found in an elaborate compilation and analysis of flood records recently presented before the American Society of Civil Engineers by C. S. Jarvis. The author combed technical literature for figures of abnormally high stream flows, and, after grouping them, succeeded in finding a general coordination of the hundreds of figures. The result constitutes another step forward toward that ultimate state of knowledge in which we will be able to predetermine the hazard to which any particular stream-valley community is exposed.

In many respects the serious study of the subject may be taken as dating from the memorable central states floods of March-April, 1913. Long before that time many individual flood problems had been investigated, and in addition engineers specially concerned with stream problems had recognized and given attention to the more general questions of floods. Nevertheless, the common tendency was to look upon floods of disastrous size as catastrophic happenings, like earthquakes or lightning strokes, and the attitude of engineers was greatly influenced thereby. Each community not yet visited by a large flood was inclined to believe itself immune. Only after 1913 did it come to be generally understood that flood danger exists along every watercourse, and that there is enough system in the attendant circumstances to warrant abandoning the fatalistic attitude of waiting for a flood to come, and substituting therefor scientific study. That the necessary study is largely of statistical nature does not make it any the less scientific.

Since that time, much has been learned about extreme floods. Moreover—and this is perhaps the principal gain—such widespread attention has been focused upon the subject that every record flood is now subjected to careful observation and recording of all discoverable data relating to precipitation, ground and water conditions, stages and discharges. Outstanding additions to flood knowledge made within the last twelve years are the studies of maximum intensity of regional storms, carried out in connection with the Miami Valley flood-protection studies, and the subsequent studies of smaller and much more intense precipitations, the so-called "cloudburst storms," by Matthes and others. Mr. Jarvis' paper represents a further contribution to the subject, of another kind.

So many variable and erratic influences affect flood flow that regularity of any kind seems almost impossible. Among these influences are climate, stream hydraulics, drainage geography and topography, storm distribution, and previous moisture accumulation in or on the ground.

Illustrating the resulting irregularity of flood flows, it was recently reported by J. F. Seiler and E. E. Payne (in *Wyoming Roads*, March, 1925) that in Wyoming the flood discharges for drainage areas varying over a wide range of size are practically constant (about 18,000 sec.-ft. for areas from 1,000 to 4,000 sq.mi.). This is a condition very different from that found under other circumstances of climate, characteristic storm type, and topography. Despite such irregularities, Mr. Jarvis nevertheless finds that when all the extreme flood records from the entire country, and in fact from all the world so far as he could find them, are brought together and are plotted to ordinates of runoff intensity (second-feet per square mile) on a base of drainage area they group together in a well-defined belt, whose upper and lower bounding curves are parallel and follow a very simple rule. The rule is not new, but is perhaps the simplest of the many flood-flow formulas that have been suggested in the past: Flow intensity varies inversely as the square root of the drainage area, or, total flow varies directly as the square root of the drainage area. When flow and area are expressed in second-feet and square miles respectively, the middle line of the belt has the coefficient 1,000, while the lower and upper boundaries have the coefficients 50 and 10,000 respectively. All points within the belt represent extreme flood flows, but for different kinds of river. Points near the lower boundary represent streams of very uniform flow or of low flood volume, while those near the upper limit represent streams that either are flashy or for other reasons have a high flood flow.

In spite of the author's patient compilation and skillful analysis of data, his results unfortunately have no direct value for flood prediction on a particular stream. Not only does one stream belong higher (or lower) than another, within the belt he has traced out, but its individual law of variation with drainage area may be quite different from the square-root law. Both the change in physical conditions along the course of the stream, and the meteorological conditions affecting the nature of maximum storms in that particular region, are factors in determining the law of variation for the individual stream. Mr. Jarvis suggests that in order to apply his flood chart to individual streams, different streams should be given ratings representing percentages of the upper value of his chart, so that, for example, one stream would have a rating of 10 per cent at mid-length of its course, and 15 per cent at its mouth; another stream might have ratings of 35 and 40 per cent respectively at corresponding points. However, a stream cannot be rated dependably until after its flood maximum is known, and when this is known the rating no longer serves any purpose. Whether the same rating would apply for streams in adjacent drainage areas, or lying within the same physiographic region, is quite doubtful, since the rating includes both the effect of stream geography and the effect of storm characteristics. The latter factor, however, is the real unknown of the flood problem. The problem will not be actually within sight of its solution until storm possibilities and characteristics are better known than now.

Others in the meantime are studying flood flows from other points of view. Prominent among these is a committee of the American Society of Civil Engineers, which has been engaged in study of the subject for a year or more. Far more remains to be done in the field of flood study than has yet been accomplished, and the labors of many more investigators can fruitfully be applied to the subject.

Sinking Pneumatic and Open Caisson Foundations for Philadelphia-Camden Bridge

Piers Founded at Depths of 60 to 85 Ft.—Caissons Have Steel Working Chambers and Refuge Passages in Roof—Group Foundations for Anchorages Sunk as Open Caissons—Dredging and Dry Excavation

BY CHARLES CARSWELL
Assistant Engineer, Delaware River Bridge Joint Commission, Philadelphia

DEEP foundation work of varied types presenting many unusual difficulties was required for the construction of the piers and anchorages of the 1,750-ft. Philadelphia-Camden suspension bridge over the Delaware River. Pneumatic caissons were used for founding the main piers, but the anchorages are carried on groups of open caissons. A number of points of improved design, and unusual care and precautions in construction, distinguish the work. The main pier caissons were built of steel and timber—timber shell carried on an all-steel working chamber—and were provided with self-supporting cutting edges, which avoided the necessity for obstructing the working space with cross-ties and braces. The anchorage caissons were reinforced-concrete structures with steel cutting edges. They included some of the largest foundations of the open-dredged type ever built. Due to the local conditions it was possible, however, to bottom and seal them in the dry.

Size of Structures—Both piers and anchorages are of concrete construction faced with massive granite masonry. The main piers are each 58x140 ft. at the coping courses of masonry, and 68 ft. 8 in.x143 ft. at the base of the caissons. The anchorages, located 672 ft. back from the centers of the main piers, are 218 ft. long by 148 ft. wide in the body and 192 ft. over stair towers. In Philadelphia the location and length were practically fixed by the streets, as it was desired to leave both Delaware Ave. and Front St. unobstructed; the Camden layout was made the same.

Foundation Rock—Bedrock is located 60 to 65 ft. below datum in Philadelphia, and 85 to 105 ft. below datum in Camden (datum is 2.43 ft. above mean high water). It is overlain by softer micaceous schist of varying thickness. Diamond drill borings at both pier and anchorage sites to determine the depth and contour of the rock surface made possible the construction of the pier caissons to correct height before sinking, and thus avoided delays in sinking or difficulties from underwater cutting of the caissons.

Pier Design Problem—Each of the main piers required a single foundation shaft to transmit to the rock the loads from the cables and towers. In the initial stages of the design, studies were made of the possibility of using two small caissons to construct the foundation, but the difficulty and expense of properly tying together the two shafts ruled out this scheme. A single large caisson was adopted as best suited to the requirements. The bearing pressure at the base of these caissons is calculated to average 6.4 tons per sq. ft., with a maximum of 8.6 tons.

Anchorage Substructure—The anchorages are not ideally adapted to the use of a single foundation or of uniform foundation beneath the entire area. In each anchorage the masonry above the foundations is divided into two principal portions, one at the rear, or short end, the other at the forward, or river end. The rear portion is filled solid with concrete and supplies the weight necessary to take care of the uplift of the cables. The forward portion consists of two concrete buttresses braced by a cross-wall and connected to the rear portion by four walls; these buttresses support the legs of an inclined steel bent over which the cables are deflected from the angle of about 8 deg. with the horizontal, at which they reach the anchorage, to the angle of about 46 deg. required for their attachment to the rear portion. The deflection of the cables

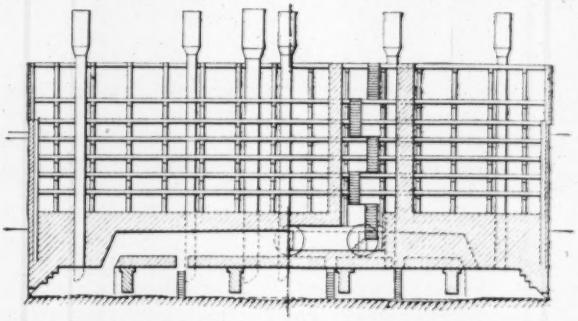


FIG. 1—MAIN PIER AND CAISSON, WITH REFUGE CHAMBER AND LOCK

produces a thrust on the bent and this inclined thrust combines with the weight of the supporting buttresses to produce a resultant force acting downward at a steep angle at the top of the foundations. The foundation requirements are therefore for a support beneath each buttress to transmit this resultant force to the rock and for a uniform support beneath the rear portion, and the foundations must also provide security against slipping due to the horizontal component of the cable pull.

Nevertheless the possibility of using a foundation mat 20 to 30 ft. in depth beneath the entire anchorage was investigated. This would have given a stable base with low bearing pressures, but was abandoned because (1) the cost was estimated to be no less than that of the design finally adopted, (2) it was considered inadvisable to have the foundations at less depth than that of possible future structures on adjacent property, and (3) rock foundation was preferred, for greater security. In any event it was desired to carry the Camden foundation below a stratum of clay which the borings had revealed, 60 ft. below the surface.

A scheme for 20 small pneumatic caissons to be sunk to hard rock beneath each anchorage was studied. In order to take care of the horizontal force, it was proposed to sink the caissons inclined at the angle of the average resultant force. No precedent could be found to show that caissons could be sunk on a fixed slope, however, and the cost of this scheme was found to be excessive (1) because of the size of shaft required to

provide for variation in the inclination of the resultant, and (2) because of the high cost of pneumatic work, particularly in Camden, where the depth to rock approaches the limit for compressed-air work.

Studies of open-dredged caisson foundations were then made and the adopted design was developed from them. The first of these studies was for the use of six 40x70-ft. caissons arranged three on each side, sunk to 20 to 30 ft. above the rock and tied together. This arrangement secured low bearing pressures, but

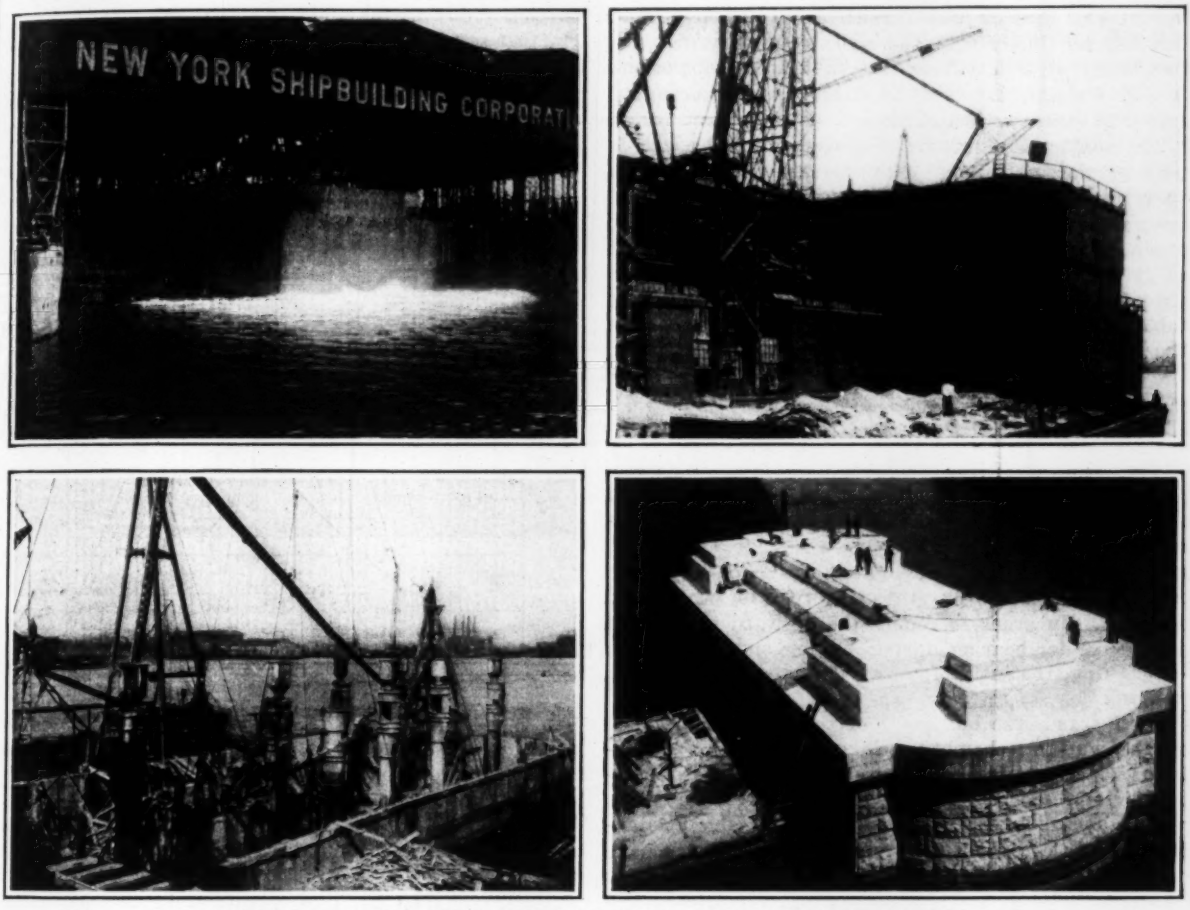


FIG. 2—PIER CONSTRUCTION SEEN AT DIFFERENT STAGES OF THE WORK
Launching Philadelphia caisson. Caisson at the site before sinking.
Camden caisson in final position. Granite pier superstructure.

did not adequately support the rear portion of the anchorage. It was modified to a scheme for two 40x70-ft. caissons on each side at the forward end beneath the buttresses and a series of 12 circular caissons beneath the rear portion, all sunk to rock. The adopted design substituted a single large caisson on either side for the two shorter ones. This plan avoided the necessity of tying the two caissons together, which would have been costly and might have involved pneumatic work. It was decided that 140-ft. caissons, although larger than had previously been constructed, could be handled safely and economically. Further economy was effected by reducing the length of the Philadelphia caissons to 125 ft., which, with the less depth to rock, gives the same relative location of the line of pressure and equivalent rigidity as the longer caissons in Camden. Eight of the twelve circular caissons are 20 ft. in diameter and are located beneath the main anchorage structure; the other four, 16 ft. in diameter, support the stair towers on the sides of the main structure.

The bearing pressures at the base of the caissons were computed by study of the elastic behavior of both the foundations and the anchorage above them. Net pressures were computed after deducting side friction of 400 lb. per sq.ft. and after deducting the weight of soil displaced; the net pressures thus obtained represent the difference between the pressure under the caissons and that in the adjacent material due to the overlying soil. For the rectangular caissons the maximum pressure occurs under maximum-load conditions, for the circular caissons on rock before the masonry was started, also constructing the granite masonry to exact location.

Construction of Pier Caissons—The pier caissons, 69 ft. 8 in.x143 ft., were built 40 ft. high. A permanent cofferdam, 10 ft. high at Philadelphia, 33 ft. high at Camden, surmounts the caisson. This cofferdam was reduced in width, for economy, to conform approximately to the lines of the masonry. An additional temporary cofferdam 15 ft. high was used during construction to extend the walls above water during the later stages of sinking and thus permit landing the caissons on rock before the masonry was started. This made it possible to construct the granite masonry to exact location.

The roof of the working chamber was braced by steel trusses 15 ft. deep, running in both directions. The

transverse trusses were designed to furnish the principal stiffening for the roof, and the longitudinal trusses were considered merely as distributing girders. The side walls of the caissons provided the main longitudinal strength for support during launching and handling up to the time that concrete was placed. The cutting edges and the entire working chamber are of all-steel construction. The caisson walls above the working chamber consist of horizontal courses of 12x12-in. timbers bolted to channel posts connected with the trusses. Above the trusses, bracing was furnished by transverse and longitudinal timbering. The walls were sheathed with two layers of 3-in. timber, the first diagonal and the second vertical, and this sheathing was thoroughly calked to secure watertightness.

The construction of the V-shaped cutting edges is perhaps the most noteworthy feature of the design. It eliminated all necessity for using cross-ties and braces that obstruct the working chamber space and it produced a cutting edge that was more accessible and of greater strength than the cutting edges of caissons used in the past for large bridge work. The following table compares the strength of these cutting edges with those of several other notable caissons:

	Outward Thrust lb. per ft.	Inward Thrust lb. per ft.
Quebec	2,600	26,000
Manhattan	5,000	36,000
Metropolis	7,000	87,000
Delaware River Bridge	55,000	70,000

The Delaware River Bridge design is the only one in which the toe is almost as strong against outward as against inward thrust. This strength is important to the security of a caisson because outward thrust may be developed during sinking if the cutting edge rests upon boulders or projecting rock or other hard material. In order to reduce the outward thrust and to provide for bearing during sinking and for the use of blocking, the inside faces of the cutting edges were stepped.

Four transverse bulkheads of timber were provided in the working chamber. These bulkheads were designed to support the entire weight of the caisson during sinking, in order to relieve the cutting edge of the weight and allow excavation all along the edge as sinking progresses, which removes danger of local damage to the steel from projecting rock or boulders. Support upon the bulkheads also secures more complete control during sinking, particularly when the caisson is passing through soft material or through material which is not of uniform consistency over the entire area.

All-Steel Working Chamber—The all-steel design was developed by careful study and analysis. Twelve distinct studies were made for the caisson. The first was for all-timber construction, employing cribbing of the type used in the Quebec caissons. In later studies combination trusses were developed, with steel tension rods, cast-iron blocks and timber chords and posts. Analysis of these trusses showed that enough metal was used to make good steel trusses, and the steel truss design was then developed and adopted. The use of the steel-plate roof followed naturally after the adoption of the steel trusses, and it was found, in addition to its distinct advantage in reducing fire hazard, to be more economical, the cost being about one dollar less per square foot than for timber. The development of the all-steel cutting edges was the final step in the design.

Emergency Chamber and Locks in Roof—Unusual provisions were made for the safety of the workmen. An emergency chamber capable of accommodating 80 men was constructed in the mass concrete just above the working chamber roof. This was designed to serve as a refuge chamber for the entire shift in case a blow-out or other accident occurred in the working chamber. Access to it was had from each of the five compartments of the working chamber by separate manholes through the roof, each provided with a ladder. It had an independent air supply line, but it would have served as an air reservoir, on the principle of the diving bell, even if the air supply failed. No emergency developed during the sinking of the caissons, but the chamber served a very useful purpose as a communicating gallery by which the men reached the working compartments without the necessity of passing through successive bulkheads.

At the level of the emergency chamber were two horizontal tunnel-type air locks, 8½ ft. in diameter and 15 ft. long, each capable of holding 40 men at one

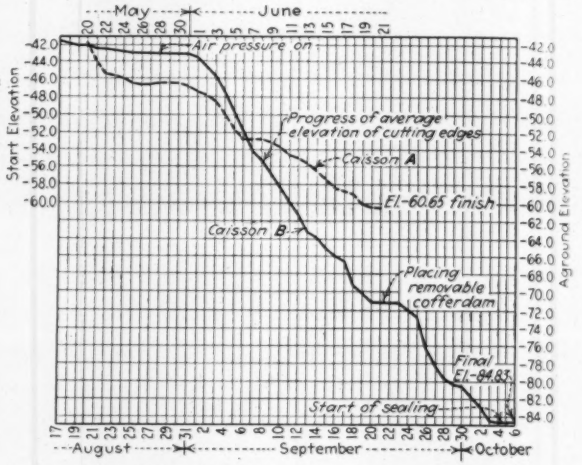


FIG. 3—SINKING DIAGRAMS OF PIER CAISSONS

time, or of seating 30 men with comfort. Access to these locks from the outside was by means of a stairway in an open shaft, leading to the top of the caisson. The stair shaft was constructed with concrete walls built up in advance of the main concrete to above the water level, to protect it from flooding in case an accident should cause the caisson walls to leak. The horizontal air locks were originally thought of as emergency locks. A vertical lock opening to a 4-ft. man shaft equipped with an elevator bucket, installed at the center of the caisson, was designed as a regular service lock, but in the handling of the work this lock and hoist were never used, and the large horizontal locks became the service locks.

In addition to the provisions for safety made in the design of the caissons, safety facilities were furnished in accordance with the state laws, including medical attention and special hospital rooms equipped with hospital locks for treatment of men affected by the compressed air.

Exceptionally favorable conditions attended the building of the caissons. The New York Shipbuilding Corp. was the subcontractor for the caisson construction, and the work was done on the covered shipways of its Camden plant, located a short distance below the bridge site. The shipyard plant experience was valuable in making for good workmanship. The caissons were built to their full height before launching, and were launched upright. A false bottom of timber was pro-

vided over the entire working chamber to break the force of the water in launching and to protect the cutting edges and bulkheads from damage.

After being launched the cassions were towed up the river to the site and moored in position. When launched, the caissons weighed about 1,800 tons and drew 12½ ft. of water. The site had previously been prepared to receive the caissons, by dredging to the depth of 40 ft. It was thus possible to sink them 27½ ft. before the cutting edge came in contact with the river bed. The load required to sink this depth necessitated the placing of 12 ft. of concrete over the roof of the working chamber. This concrete, in addition to the steel trusses, made the structure very rigid while it was stilll floating. Before air pressure was applied, the concrete was brought up above the top chords of the trusses.

The plants provided on the two sides of the river were almost identical, although arranged differently to suit local conditions. On the Philadelphia side, the entire plant was located on Pier 11. Six compressors were provided, with total rated capacity of 5,000 cu.ft. per minute. One of these compressors could be operated as a high-pressure machine to furnish pneumatic power for drills in the caissons. Six 100-hp. boilers were provided, which also furnished steam for the two 1-yd. concrete mixers, the hoisting engines, pumps and other auxiliary equipment. The concrete chuting towers were on the end of the pier, about on the center line of the bridge. The plant in Camden was the same except that the compressors and boilers were located about 1,400 ft. from the caisson. The concrete chuting towers were on an adjacent pier, requiring longer distributing chutes than in Philadelphia.

Sinking the Caissons—The Philadelphia caisson was built and sunk in advance of the Camden caisson. Throughout the sinking operation it was maintained in approximate load balance by regulating the amount of concrete placed so that it just balanced the flotation. No warping of the cutting edge or distortion of the side walls was observed. The Camden caisson was therefore handled with considerably more load, which secured greater speed in excavating and sinking. Some sand and gravel was removed by blowing but in general the excavated material was hoisted from the working chamber in buckets. The usual procedure was to support the weight on pillars of unexcavated material left beneath the bulkheads, until the mucking had proceeded below the caisson. The pillars were then robbed until they crushed and thus permitted further settlement. The average rate of sinking under compressed air was 6½ in. a day for the Philadelphia caisson and 15 in. a day for the Camden caisson.

In their final positions, the caissons are very close to the intended locations. The Philadelphia caisson is located with the center 4 in. upstream from the bridge center line and with a skew of 8 in. At the time excavation was started the skew had been 10½ in., and this had increased to 12 in. when the cutting edge reached El.—48 feet. The position was improved by use of timber rakers placed at 45 deg. to the cutting edge, and by similar use of seven 100-ton jacks. The jacks were used at El.—52 feet and secured a shift of the caisson of one-tenth foot in one foot of sinking. The cutting edge is 8 in. out of level across the diagonal; its average elevation is —60.65 feet. The Camden caisson is 1½ in. upstream from the center line and with a skew of 3½ in.; its cutting edge is 4 in. out of level across the diagonal and rests at average elevation —84.83 feet.

Undercutting—The rock beneath the Philadelphia pier is a mica schist with strata upset at an angle of 60 deg. with the horizontal. Along the east side of the caisson, the surface was generally level. Along the west side, the rock sloped down from 1 ft. below the cutting edge at the southwest corner to 11 ft. at the northwest corner. Careful soundings showed that the rock surface was not below this depth at any point. In order to avoid the larger volume of rock excavation which would have been necessary to sink the caisson further, it was decided to underpin the west cutting edge with a concrete wall down to rock. This underpinning was done by trenching in alternate sections 10 ft. long and about 3 ft. deep, so that the height exposed to air leakage or possibility of a blowout was at no time more than 3 ft. The air pressure during

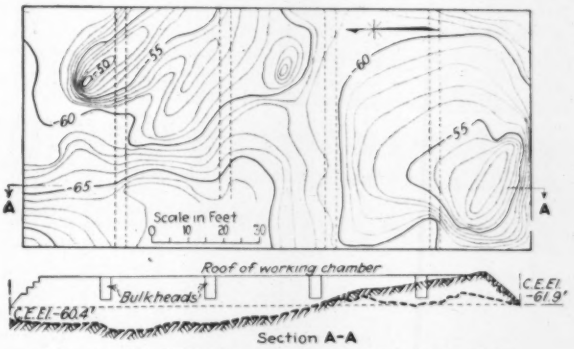


FIG. 4—FOUNDATION BED OF PHILADELPHIA PIER CAISSON

the time this operation was in progress was 28 lb. per sq.in. For most of the length of cutting edge underpinned, one or two stages of 3 ft. each were sufficient, although in the extreme northwest corner four stages were required. The precaution was taken of packing the exterior face of the trench with stiff plastic clay as rapidly as the sand was exposed. The operation was entirely successful, and the balance of the rock surface could then be cleared off, ready for sealing the working chamber with concrete.

Very little of the rock surface in Philadelphia was disintegrated enough to require removal. The maximum depth of rock excavation, at some of the high points, was about 8 ft. Drilling and blasting were carried on without difficulty. At the time of blasting, the electric light cords were taken up into the refuge chamber by the workmen, who remained in that chamber under the air pressure without locking out.

Air and Temperature—The Camden caisson passed through 11 ft. of hard blue clay, from El. —52 to El. —63. This clay stratum formed a tight seal which reduced greatly the amount of air passing under the cutting edge and lowered the working-chamber air pressure below the normal hydrostatic pressure. The pressure dropped from 21½ lb. with the edge at El. —52 to 17½ lb. with the edge at El. —55½. Throughout the remainder of the sinking, the pressure was from 3 to 5 lb. below the hydrostatic pressure, and the quantity of air passing into the chamber was so relatively small that blowing through the muck shafts and blow pipes was resorted to in order to secure proper ventilation. The rock surface was overlain with disintegrated mica, which increased gradually in hardness until rock was

reached which could not be removed except by blasting and which was satisfactory for the foundation.

At the time of sealing the Philadelphia caisson, the immersion at high tide was 58 ft. and the air pressure was 28 lb. per sq.in. When the Camden caisson was sealed the immersion was 82 ft. and the air pressure was 34 lb. per sq.in.

The temperatures inside the working chamber in Philadelphia were from 85 to 90 deg. except during sealing, when they averaged 99 to 103 deg. To secure some relief during that period, the 4-in. pipe line which supplied the refuge chamber and one compartment of the working chamber was hooked to 160 ft. of 4-in. pipe grid which was lowered into the river. This grid cooled the air blast from an average of 105 deg. to 85. It did not materially affect the temperature in the working chamber, because the main 6-in. supply lines pumped uncooled air, but it afforded two relief spots where men could cool off. The temperatures in the Camden caisson were lower because the air supply pipes ran under water for about 400 ft. The range was from 71 to 97 deg., and the average for the entire time of sinking was 79. During sealing the temperatures rose to an average of 89.

Concreting the Working Chambers—Sealing was accomplished by locking in concrete through special concrete locks placed at the top of the muck shafts above the locks used for handling the buckets. These locks had a clap valve at the bottom and the concrete was allowed to fall from them into the working chamber. A laborer stationed inside the regular muck lock cleaned off the valve after each dumping. After the concrete had been brought to within 4 ft. of the roof of the working chamber, concrete was placed simultaneously through both shafts in the same compartment. As the concrete surface approached the roof, the air pipes entering through the roof were occasionally blown to relieve any air pockets and to permit the concrete to flow toward the pipes located in the corners of each compartment. It was found impossible to get tight pressure against the roof of the working chamber even with a 20-ft. head of wet concrete in the shafts. The difficulty was overcome by sending laborers into the chamber and they, lying prone, raked the concrete away from the shafts to the low corners until there was no longer space for them. The concrete was then raked toward the refuge chamber openings as long as the hoes could be worked between the concrete and the roof, and was churned through the openings until it ran over. Final filling to the roof was accomplished with mortar under a pressure head from the shafts. After the air pressure was taken off, grout was pumped in under pressure to complete the seal and block all pipes. The grouting operations showed that the sealing was entirely successful.

Large Anchorage Caissons—The rectangular caissons for the anchorages are 40x125 ft. in Philadelphia and 40x140 ft. in Camden. Each caisson was designed with 12 dredging wells, in two rows of 6, each 10 ft.x11 ft. 4 in., to secure control during sinking. The outside walls were 6 ft. thick, the central longitudinal wall 8 ft., and the interior transverse walls 9 ft. (Philadelphia) and 12 ft. (Camden). All outside walls were vertical. The cutting edges were V-shaped, with the sloping faces stepped to provide positive bearing on the filling concrete, to avoid outward thrust, and to permit the use of blocking to support the caisson during construction.

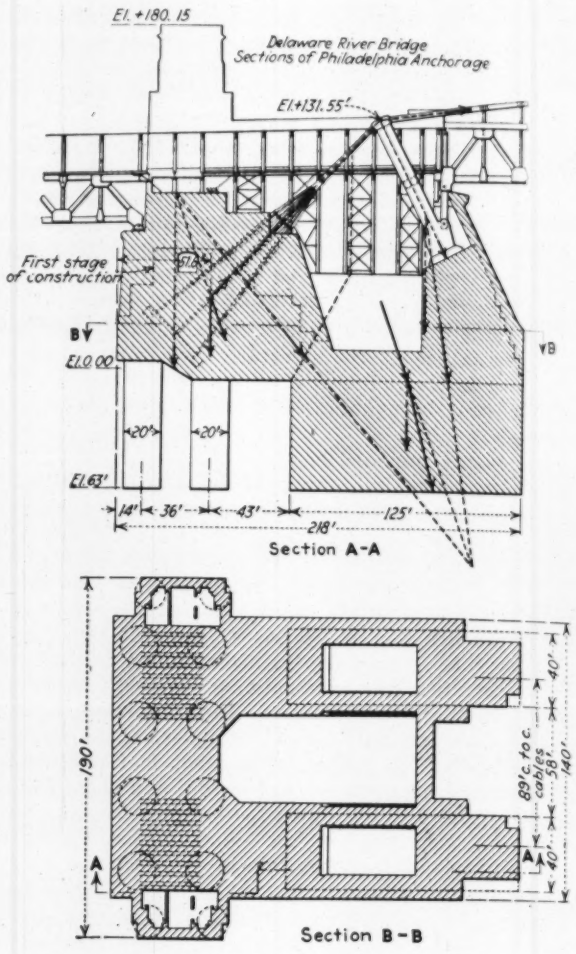


FIG. 5—ANCHORAGE FOUNDED ON GROUP OF OPEN-DREDGED CAISSONS

For calculating the internal forces the anchorage was considered as composed of separate front and back parts. The force diagrams in the elevation (upper drawing) indicate the result. In the back part (left) the cable pull is combined with the weight of the back part to obtain the resultant force, which divides between the load imposed on the circular caissons and an inclined thrust transmitted to the front part. The reaction of the circular caissons is taken as vertical, because of the great horizontal stiffness of the rectangular caissons, and is assumed to act 2 ft. back of the median line between cylinders. The thrust transmitted to the front part through the narrowest section is so placed as to give a tension at the top of the wall equal to half the average stress on the section, since hogging stresses must exist in the anchorage as a whole. These assumptions permit of resolving the back resultant. The front forces are obtained by combining the load of the steel bent with the weight of the front part; combining the resultant with the thrust from the back part; and combining the last resultant with the caisson weight.

The steel cutting edges were stiffened and bedded into the concrete walls by angle frames 3 ft. on centers. These frames contributed to the strength of the toes against lateral pressure and protected the concrete in the sloping portion against excessive spalling from the buckets hitting.

The dredging wells were designed with 9-in. recesses 4 ft. high, spaced 6 ft. apart, to receive a bulkhead in case compressed air had been found necessary, and to bond the filling concrete to the shell.

Design for Strength—The walls were reinforced on each side with 1-in. square horizontal rods and ¾-in. square vertical rods. Additional horizontal reinforcing was provided in the longitudinal walls to take care of lateral and vertical bending stresses during sinking. In order to proportion this additional reinforcing and to

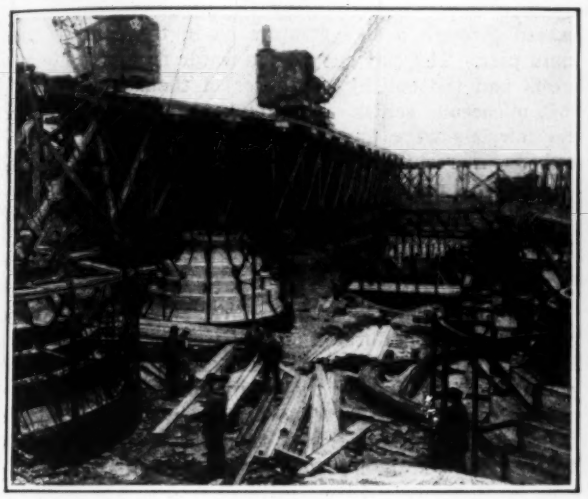
make it effective, the general procedure for constructing and sinking the caissons was prescribed in the specifications. It was required that the caissons be built to 30 ft. above the cutting edges and the concrete allowed to set for 28 days before sinking was commenced.

Accordingly this 30-ft. structure was designed on the assumption that bending stresses caused by unequal bearing at the bottom would be equivalent to those produced by bottom pressures varying uniformly from a maximum at the ends to nothing at the center or from nothing at the ends to a maximum at the center. The first condition gives tension at the bottom and the second condition gives tension at the top. The amount of the tension was computed for each 5-ft. layer, for the center and the quarter points, and sufficient horizontal reinforcing was provided to take care of the entire tension in each layer. The steel was computed at 24,000 lb. per sq.in., and only the minimum number of rods was carried the full length of the caisson, the additional rods being stopped at intervals as required. For the heights above 30 ft., the reinforcing was designed with the same assumption for distribution of bottom pressures, but allowance was made for partial support of the caissons by friction of 200 lb. per sq.ft. of embedded surface and for buoyancy. The reinforcing was designed for successive lifts of 10 ft. each above the 30-ft. height. It was required by the specifications that not more than 20 ft. should remain above ground, and it was thought that sinking would be resumed after each lift of 10 ft. was constructed. The work was handled, however, by sinking the caissons nearly level with the ground and then concreting for 20 ft. before resuming dredging.

It is to be noted that the methods employed in the design of the reinforcement avoided excessive refinement or detail of computation. No attempt was made to calculate the position of the neutral axis or to apply the theory of reinforced-concrete beams. It is believed that the uncertainties of the problem are too great to warrant such detail in computation.

Circular Caissons—The circular caissons were each designed with a single 8-ft. dredging well. The 20-ft. caissons had 6-ft. walls and the 16-ft. caissons had 4-ft. walls. All walls were reinforced inside and outside with vertical rods and with hoops, and provision was made by recesses on the inside face for the possible use of compressed air and for bonding with the concrete filling, as in the rectangular caissons. The cutting edges were of steel, similar to those of the large caissons, except that the toe was more slender and more sharply pointed. This toe design was intended to minimize the difficulties from friction, which would be greater than in the case of the rectangular caissons because of the larger external surface compared to the weight.

Construction—Interior forms for the sloping portion at the bottom of the dredging wells were of timber construction. All other forms were of steel, which was well adapted to the requirements for repeated duplication of work. Alignment of the exterior forms was maintained by steel trusses supported at the top of the form sections in a horizontal plan. Special provision was made in the construction of the forms to secure correct vertical alignment through successive lifts. Two lines of holes, one near the top and one near the bottom, were punched in the forms. The lower line served to hold the form in place, while the upper holes were templet holes for placing bolt fastenings to hold the forms during the next stage.



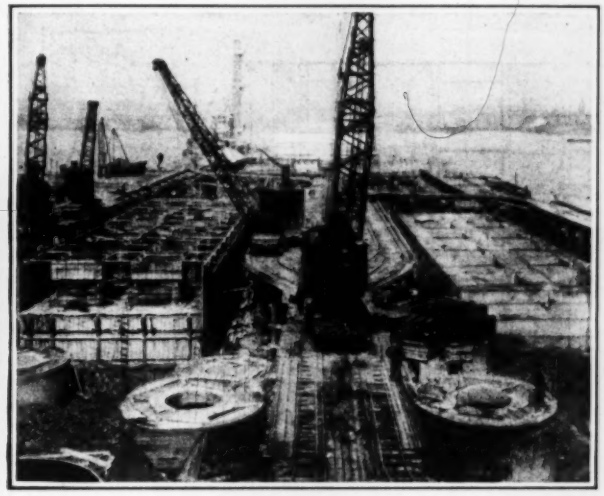


FIG. 6—CAMDEN ANCHORAGE: FORMING THE WORKING CHAMBERS, AND CAISSON DREDGING IN PROGRESS

Concreting was begun in December, 1922, and was continued throughout the winter. The work was protected against freezing by heating the aggregate and water before mixing and by heating the green concrete during the period of setting. For the latter protection, an unusual method was used on the rectangular caissons in Philadelphia. A pipe in which holes were punched was placed entirely around the caisson at the bottom of the lift to be heated, and connected with the steam boilers in the contractor's plant. A canvas cover was then placed on the caisson and brought down over the pipe. The steam passed out through the holes in the pipe and produced a warm moist atmosphere that was very favorable for the setting of the concrete. For the circular caissons and for all the Camden caissons, where the steam boilers were not as conveniently located, salamanders were used.

Sinking—Excavation through the dredging wells was accomplished by orangepeel buckets. Deflections of the caissons were found to be controlled readily by dredging through the proper wells. No objectionable warping occurred in any caisson.

In the north rectangular caisson in Camden, two diagonal seams about $\frac{1}{2}$ in. wide were observed on the third day of sinking in the lower half of the north side, near the east end. Dredging was directed to secure greater bearing at the center and the seams closed as the caisson sank into the ground. In the handling of each of the rectangular caissons, precautions were taken to maintain tension in the cutting edge and thus insure the concrete at the top against cracking. The supporting sills in the central portion were released first, and dredging through the central wells was started before the sills were removed from the ends. This procedure was uniformly successful with the other caissons. It is probable that in this one case the dredging beneath the central portion had been carried too far on the north wall and thus created excessive stresses.

The caissons were sunk to the depth of about 50 ft.

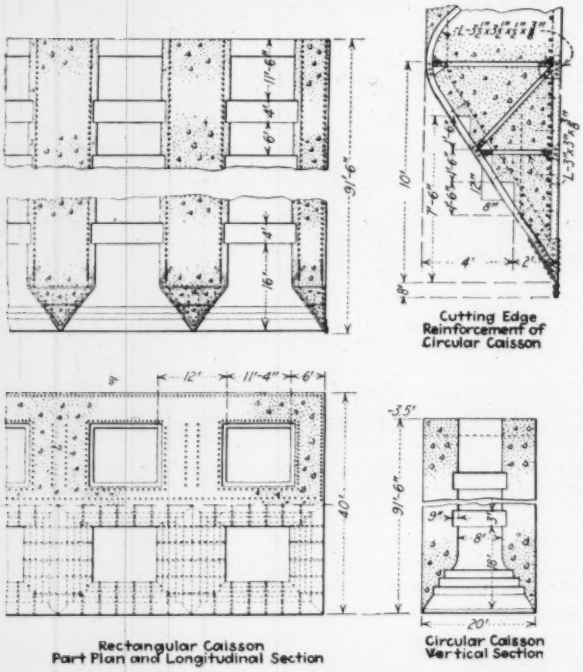

Cutting Edge Reinforcement of Circular Caisson
Rectangular Caisson Part Plan and Longitudinal Section
Circular Caisson Vertical Section

FIG. 7—CONSTRUCTION OF RECTANGULAR AND CIRCULAR ANCHORAGE CAISSONS

by dredging through the water-filled wells, but at this depth difficulty was experienced in the sinking. Water jets, of several forms, were of no asssistance. The south rectangular caisson in Philadelphia was the first to become "hung up." The cutting edge had reached El.—52. Excavation had been carried below the edge, and examination by divers indicated that the walls had very slight bearing. Pumping out of the wells was finally resorted to in order to decrease the buoyancy. When the water level had been reduced 15 ft., this caisson suddenly dropped nearly a foot. The net weight at the time was 1050 lb. per square foot of exterior embedded surface. It was concluded from the suddenness of the drop that skin friction was a large factor in hanging up the caisson. After the experience with the south caisson in Philadelphia, pumping was employed on all the caissons to increase the weight available for sinking.

Caissons Bottomed in the Dry—It was found so simple a matter to pump out the caissons that they were completely unwatered in every case and excavation completed in the dry by hand labor. This method proved more rapid and more satisfactory than any available means of working through the water. To prevent damage to the caissons and to control them perfectly while they were being sunk by hand excavation, they were supported by timber posts on sills beneath the stepped portions of the concrete. After excavation had been carried to the depth at which another drop was desired, the supports were removed simultaneously by blasting.

Pumping conditions differed widely on the two sides of the river. The rock surface in Philadelphia was uneven and very hard, and the flow of water was in such large volume that partial backfilling was required to cut it off in the deeper pockets. In Camden the caissons passed through a clay stratum as in the case of the main pier. The clay cut off the water from the higher levels and the cutting edges sealed themselves in the soft micaceous schist. So effective was this seal that the caissons were unwatered by bailing with buckets and as a result staging down of the pumps was avoided.

While the caissons were pumped out it was possible to inspect the cutting edges thoroughly. The edges had been damaged in only a few places and were generally in excellent condition.

Sealing Caissons—The procedure for sealing the rectangular caissons differed on the two sides of the river. In Philadelphia the wells were drained to the central portion and the water then pumped out through the central dredging wells. The drained wells were sealed in the dry, and pumping was then discontinued and the two open wells allowed to fill with water, after which they were sealed by tremie. In Camden, the wells in which the greater flow occurred were drained and sealed first. Then the water was removed from the last wells by pumping through the pipe while concrete was placed in the wells to the height of ten feet. After this concrete had set, pumping was discontinued and the pipe capped to cut off the flow. This procedure avoided the use of a tremie.

The circular caissons were all sealed in the dry, pumping being discontinued when the concreting operation was started, and the filling completed rapidly enough to prevent its disturbance by seepage of ground water.

Contracts and Personnel—All the foundations have been constructed by the same contracting organization. The main piers and the anchorage foundations (except the 16-ft. caissons), together with the first section of the masonry of each anchorage, were built under contracts secured by the Keystone State Construction Co., Philadelphia, and Holbrook, Cabot & Rollins Corp., New York, acting jointly. The four smaller caissons have been built under a separate contract for the completion of the anchorages, awarded to the Keystone State Construction Co.

The work was designed and executed under the direction of Ralph Modjeski, chief engineer of the Delaware River Bridge Joint Commission and chairman of the Board of Engineers, of which George S. Webster and Laurence A. Ball are members. Daniel E. Moran is consulting engineer on foundations.

Rapid Railroad Construction on Florida Line

Many Machines and Large Forces Build 204-Mile Cross-State Line in Few Months—Long Tangents—Steam Tracklayers

RAPID railroad construction was accomplished in building the new 204-mile Florida extension of the Seaboard Air Line from Coleman, Fla., southeast to West Palm Beach on the east coast, during 1924. This important addition to the railway system of the state not only extends the railroad through new country and across the central ridge or backbone to an east-coast terminal, but also gives a direct cross-state route of 185 miles between Tampa and Palm Beach by means of a connection with an older branch at Lake Wales, as shown by the accompanying map. The entire line, which was put in operation in January, was built in about ten months from the date of signing the contract, and most of the work was done in six months, which is considered a high record for a line of such length.

About 96 per cent of the line is on tangent and its location includes two tangents of 57 and 37 miles in length. The sharpest curvature is 2 deg. and the maximum grade only 0.3 per cent. Only two important bridges are required; one of 276 ft. over the St. Lucie Canal and the other of 150 ft. over the Kissimmee River; each of these has a swing-span for the navigable channel. The amount of timber trestle is comparatively small. There are several grade crossings of the Atlantic Coast Line, the most important of these being protected by interlocking plants, but at Avon Park the grades are separated and the new line passes under the other. Terminal facilities at West Palm Beach will include passenger and freight stations located near the center of the city and on the bank of a large lake, the latter precluding the possibility of future trouble from grade crossings due to street extensions. Brick and tile stations have been built at several points. A coaling station with 200-ton elevated bin installed at West Lake Wales, was in operation 61 days after the award of contract. The route length is 204 miles, with 238 miles of track, all laid with 100-lb. rails.

Beyond Coleman, the line traverses country of moderate elevation and after crossing the Withlacoochee River

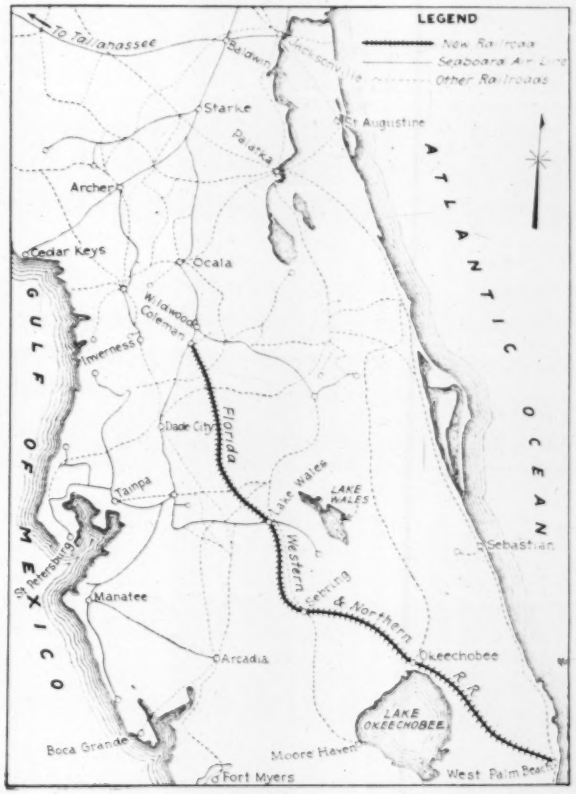


FIG. 1—FLORIDA EXTENSION OF SEABOARD AIR LINE

it strikes a highly developed section known as the "citrus highlands." Here the road has the appearance of being in an upland country owing to the large cuts and fills, with a maximum depth of 33 ft. and 17 ft. respectively. However, the material was easy to handle so that the heavy work progressed rapidly. After passing this ridge country, just south of Sebring, the line approaches the coastal plain and descends to lower levels.

Dragline excavators were used extensively in the swampy country, about twenty-five machines being employed. A wheel excavator or ditching machine was also used for some of the wet borrow pit work. Steam

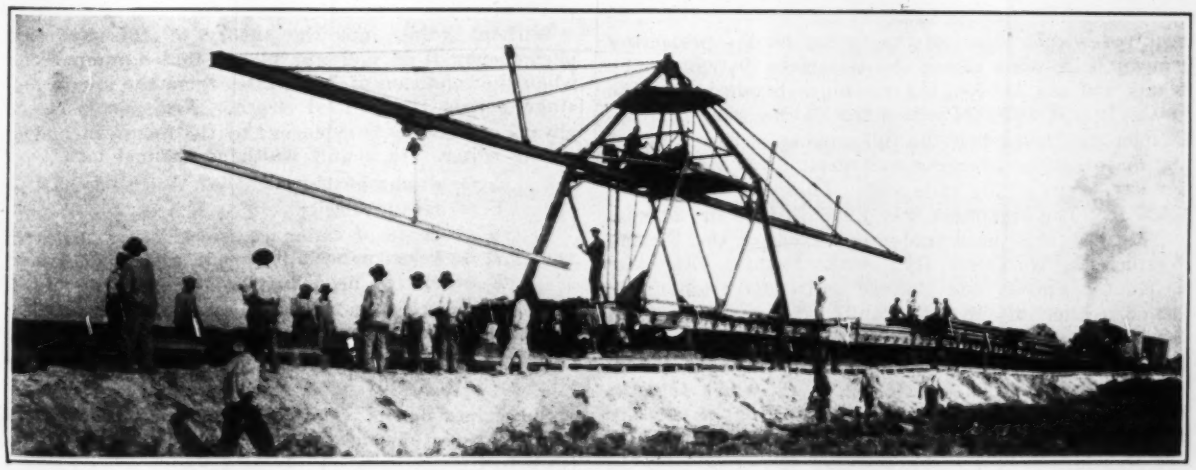


FIG. 2—TRACKLAYING MACHINE ON FLORIDA LINE

FIG. 3—ONE OF THE TRESTLES ON NEW FLORIDA RAILROAD

shovels served by trains of large air-operated dump cars handled the heavy excavation in the dry ground, while teams and scrapers did some of the lighter work.

For the tracklaying, three steam tracklayer machines of the Clyde overhead carrier type were employed, one of which is shown in Fig. 2. A steel truss frame on a large flat car supports a runway 90 ft. long which extends beyond both ends of the car and carries a 2-ton hoisting trolley; the cables of this trolley are operated by a steam hoist mounted above the runway. Ties loaded on a car behind the tracklayer are made up in bundles to be carried forward by the trolley and dropped on the roadbed, to be distributed by hand. Rails carried on the deck of the tracklayer are handled in the same way and lowered in place on the ties. With hoisting and traveling speeds of 100 ft. and 200 ft. per minute respectively, the trolley can handle material quickly.

This machine was designed originally for work on logging roads where speed of construction is not of great importance and only one load of rails and ties need be carried (see *Engineering News-Record*, Feb. 19, 1920, p. 373). But on the Florida line as many as four cars of rails and ties were between the tracklayer and the locomotive, the materials being moved forward as required within reach of the trolley on the projecting runway. In some places the ties were distributed by teams and the tracklaying machines handled only the rails. It is stated that with a tracklaying gang of 18 to 24 men and laying half the full number of ties ahead of the machine, the progress was about 3,400 ft. of track per day, when laying rails only. This was increased to 6,600 ft. The maximum was 7,936 ft. in 8 hr. 20 min.

This new line, built under the name of the Florida Western & Northern Ry., with Fleming Ramsaur as chief engineer, was planned and constructed under the direction of M. H. Cahill, vice-president, and W. D. Faucette, chief engineer, of the Seaboard Air Line. The general contract was awarded to the Jefferson Construction Co., Charleston, S. C., which sublet a large part of the grading. The rapid progress already noted was accomplished by the extensive use of machinery in addition to a large working force, as many as 6,000 men being employed at one time.

Determining the Energy Lost in the Hydraulic Jump

Analysis Deals with Mean Velocities Only—Actual Losses Somewhat Greater Due to Unequal Distribution of Velocities

By J. C. Stevens
Stevens & Koon, Consulting Engineers, Portland, Ore.

CONSIDERABLE has been written in recent years concerning the hydraulic jump but the writer has never seen a concrete expression for the energy lost therein (converted into heat). A formula for this energy loss in terms of the initial energy present is derived in this article. Some of the earlier papers on the subject are: Theory of the Hydraulic Jump and Backwater Curves by Sherman M. Woodward, *Technical Reports*, Part III (1917), The Miami Conservancy District; The Hydraulic Jump in Open Channel Flow at High Velocity, by Karl R. Kennison, *Transactions*, Am. Soc. C. E., Vol. LXXX (1916), p. 338; and The Hydraulic Jump and Critical Depth in Design, by Julian Hinds, *Engineering News-Record*, Nov. 25, 1920, p. 1034.

Without going into the theory of this hydraulic phenomenon it is sufficient to say that a jump occurs when the condition of flow passes from the low to high stage across the critical depth. An energy loss is always present, as is evidenced by the foamy turbulence of the water. In a unit width of channel let

Q = discharge
V = mean velocity
y = depth of water
h = velocity head
E = energy head
P = pressure of water in a vertical plane
i = loss of energy head due to impact, eddies or cross currents, for brevity called the eddy loss.

Subscripts denote values of the above functions at particular sections of the channel. The weight of a cubic foot of water is considered as unity.

We may neglect channel friction in the short stretch

in which a jump occurs and consider this portion of the channel as level. The drawing shows a jump in such a channel. The energy head at any point is the depth plus the velocity head. The eddy loss is the drop in the energy heads between the sections just before and after the jump. Hence we have

$$i = E_1 - E_2 = y_1 + \frac{V_1^2}{2g} - \left(y_2 + \frac{V_2^2}{2g}\right) \quad (1)$$

This may be placed in terms of depths only. From the relation

$$Q = y_1 V_1 = y_2 V_2 \quad (2)$$

we may write

$$V_1 - V_2 = Q\,\frac{y_2 - y_1}{y_2 y_1} \quad (3)$$

and

$$V_1^2 - V_2^2 = Q^2\,\frac{y_2^2 - y_1^2}{y_2^2 y_1^2} \quad (4)$$

substituting (4) in (1) we obtain

$$i = \frac{Q^2}{2g}\,\frac{y_2^2 - y_1^2}{y_2^2 y_1^2} - (y_2 - y_1) \quad (5)$$

From the principle of the conservation of momentum we know that the momentum of the moving mass can only change as the result of an external force. In the channel under consideration the only external force present is the difference in the water pressure in the sections immediately before and after the jump. Hence from the physical law that *force equals mass* × *acceleration* we may write

$$P_2 - P_1 = \frac{Q}{g}(V_1 - V_2) \quad (6)$$

but

$$P = \tfrac{1}{2}y^2$$

hence (6) becomes, after substituting (3)

$$\frac{y_2^2 - y_1^2}{2} = \frac{Q^2}{g}\,\frac{y_2 - y_1}{y_2 y_1} \quad (7)$$

If we eliminate $\frac{Q^2}{g}$ between (7) and (5) and reduce, we obtain

$$i = \frac{(y_2 - y_1)^3}{4\,y_2 y_1} \quad (8)$$

which gives the eddy loss in terms of depths only.

A peculiar relation exists between depths and velocity heads before and after the jump, which may be utilized to express the eddy loss in terms of depth and velocity just prior to the jump. This relation follows directly from the momentum equation. From (7) we may write

$$\frac{Q^2}{g} = \frac{y_2 + y}{2}\,y_2 y_1 \quad (9)$$

but from (2)

$$y_2 y_1 = \frac{Q^2}{V_1 V_2}$$

hence (9) becomes

$$\frac{V_1 V_2}{2g} = \frac{y_1 + y_2}{4} \quad (10)$$

At the critical depth this reduces to

$$\frac{V}{2g} = \frac{y_c}{2} \quad (11)$$

which expresses the condition for critical flow, viz.: that velocity head is ½ the depth.

But (10) further states that on each side of the jump the geometrical mean velocity head is ½ the arithmetical mean depth.

From (10), since $V_2 = V_1\frac{y_1}{y_2}$ we find

$$y_2^2 + y_2 y_1 - 4y_1 h_1 = 0 \quad (12)$$

from which we may express the depth after the jump in terms of the depth and velocity head before the jump:

$$y_2 = -\frac{y_1}{2} + \tfrac{1}{2}\sqrt{y_1^2 + 16\,y_1 h_1} \quad (13)$$

Let $r = h_1/y_1$ or ratio of initial velocity head to depth. Then (13) becomes

$$y_2 = \frac{y_1}{2}(\sqrt{1 + 16r} - 1) \quad (14)$$

If this value is substituted in (8) we find

$$i = \frac{y_1}{16}\,\frac{(\sqrt{1 + 16r} - 3)^3}{\sqrt{1 + 16r} - 1} \quad (15)$$

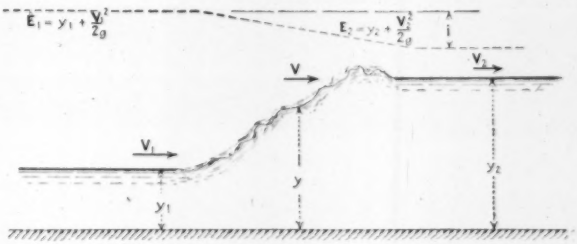
The energy lost in terms of the initial energy in per cent is given by

$$100\,\frac{i}{E_1} = \frac{100\,i}{y_1 + h_1} = \frac{100\,i}{y_1(1 + r)} \quad (16)$$

If the value of i in (15) is substituted in (16) we find the loss in per cent in terms of r alone to be

$$i\ (\text{per cent}) = \frac{6.25(\sqrt{1 + 16r} - 3)^3}{(1 + r)(\sqrt{1 + 16r} - 1)} \quad (17)$$

When $r = \frac{1}{2}$ or at the critical depth this expression reduces to zero. Furthermore the expression is negative for all values of r less than ½, that is, for initial depths above critical flow there is no jump, and consequently no loss, since a gain of energy is impossible.



HYDRAULIC JUMP IN A CHANNEL

Energy lost by impact and eddies in a hydraulic jump for various values of the ratio r is given below:

ENERGY LOST BY IMPACT AND EDDIES IN A HYDRAULIC JUMP

Values of the ratio r	Eddy Loss per cent
0.5	0
1.0	1.4
2.0	9
3.0	18
4.0	23
5.0	28
6.0	32
8.0	39
10.0	44
13.0	50

In order to lose 50 per cent of the initial energy, the velocity head must be 13 times the depth. Thus if the initial depth were 2 ft. the velocity must be nearly 41 ft. per second.

If we let $J = \frac{y_2}{y_1}$ a simple expression for the height of the jump may be obtained from (12) thus

$$J^3 + J = 4r \quad (18)$$

For the above example the final depth would be 13.5 ft. or an increase of 11.5 ft. The head lost in eddies would be 14 ft. or half the initial energy head. Such a jump would represent the dissipation of 130 hp. per unit width of channel.

The analysis given deals with mean velocity only. The actual loss is somewhat greater than shown due to the unequal distribution of velocities in the moving mass. An analysis involving the velocities of the particles, however, becomes very complex, and as a matter of practical hydraulics is not justified.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

Newark, Ohio

COUNTY SEAT OF LICKING COUNTY, 33 miles from Columbus, at junction of forks of Licking River and on Ohio Canal; situated in a plain surrounded by hills. Tributary country is agricultural but there are also areas of natural gas, coal and sandstone. Chief manufacturing interests are electric-car works, table glassware and bottle works, locomotive shops of Baltimore & Ohio R.R., stove foundry, golf-stick works, cigar, shoe, brick and motor truck factories, engine and machine works, flour mills, carriage factory, chemical laboratory. Settled in 1801, laid out as town in 1802. Pop. (est. 1924) 27,000.

IN NEWARK, Ohio, the city engineer is known as the civil engineer, engineering department, Bureau of Public Service. The chief municipal administrative functions are grouped under two officials—the director of public service and the director of public safety. In the public service bureau are the civil engineer, the superintendent of water-works, the superintendent of streets and the superintendent of the cemetery. Charles H. Wells, the civil engineer, has held that position for a number of years. His is an appointed office though confirmation must be given by the city council.

Newark is principally a city of flat gradients. However, there is sufficient high ground immediately adjacent to the city to supply a site for a storage reservoir for the water-works system. Bar gravel is available in unlimited quantities though up to the present time little use has been made of local material for pavement construction.

As is the case in so many mid-West cities of the size of Newark, pavement construction and reconstruction form the principal city engineering problem. There are in all about 38 miles of paved streets, approximately 60 per cent of which is brick and 40 per cent asphalt. The brick streets, all having been laid about 25 years ago, have deteriorated so that now extensive reconstruction is becoming imperative. Original brick roads were laid on the gravel base with a sand filler. They have deteriorated to the extent that repairs averaged in 1924 $2.12 per square yard. Reconstruction work varies, though laying an asphalt wearing surface on top of the brick is a popular method.

An interesting feature in new pavement construction has been tried out with good result. In the bar gravel the hardness of pebbles varies widely. When using this bar gravel in concrete construction, a little of which has been laid, traffic wears some pebbles away while others resist it. This is liable to lead to bad pot-holes. To overcome this defect Mr. Wells has secured excellent results by using a 1:2 mortar 1 in. thick as a covering for concrete pavement. With this mortar is put 1 per cent, by weight, of hydrate of lime. The concrete pavement is 8 in. thick.

Perhaps the most interesting feature of engineering work in the city of Newark is the development and operation of its water-works. It is a municipally owned and operated system and the city lighting is generated at the water-works pumping plant. Operation during the past few years has shown an increasing and substantial profit to the city. Water is taken from the Licking River. A recent treatment plant, of sufficient interest to merit separate description, has only been in operation a year or so.

The book value of the water-works plant was reported in 1924 as $770,192.58, of which amount $448,205 represents mains and services. The 1923 report of the superintendent of water-works shows plant revenue of $137,658 and expense of $90,889. This shows a net gain of plant ownership of $46,769, an increase of $13,000 over the previous year. To illustrate the fact that the water-works is a paying investment of the city, the superintendent of water-works reports the following figures: Cash balance Jan. 1, 1924, $26,229.88; cash balance, Jan. 1, 1923, $21,543.14; sinking-fund balance, Jan. 1, 1924, $95,875.19; sinking-fund balance, Jan. 1, 1923, $93,778.03. Total valuation Jan. 1, 1924, $770,192.58; total valuation, Jan. 1, 1923, $743,202.90; bonds retired in 1923, $33,000. This shows a balance, excluding $25,000 received by the water-works from taxation during the year 1923 and including $33,000 of bonds retired during the year, of $41,773.58. The statement of valuation includes only that part of the softening and purification plant which was paid for from water revenue. Also, the valuation is based on cost and not on current prices. A re-appraisement of all services, it is thought, would show a valuation at least $400,000 higher. The superintendent of water-works reports that had the water-works been privately owned the tax payers would have paid more to the private company for fire protection in 1923 than the total amount received by the water bureau from taxation.

Operation of the power plant cost $7,509 in 1923 and maintenance $529. Interest at 5 per cent on a debt of $12,000 was $600 and depreciation at 7½ per cent on the $30,000 investment amounted to $2,250. Total production cost of kilowatt-hours amounted to $556,050, which shows an actual production cost of $1.96 per kilowatt-hour. On Jan. 1, 1924 there were about 900 lamps in use in the city, but 140 of these were installed during 1923. In order to arrive at a fair cost per lamp, the number of lamps installed during the year was divided by 2 and added to the number of lamps in use Jan. 1, 1923. This gave an average number of lamps burning during 1923 of 830. The total cost of the light plant and operation and maintenance of lines in 1923 amounted to $18,909.63. This figure, divided by 830, or the number of lamps, gives as the cost per lamp for the year $22.78.

Sewage disposal in Newark is a combined gravity system discharging into three creeks. Plans have been made for a general interceptor and outfall with Imhoff tanks for disposal at a cost of approximately $693,000. F. A. Barbour of Boston and E. T. Bradbury of Colum-

bus, Ohio, are designers of the new project. The new sewage-disposal plant is to be voted on at the November election.

Reinforcing the Water Supply of Horton, Kansas

By N. T. Veatch
Of Black & Veatch, Consulting Engineers, Kansas City, Mo.

DEVELOPING an adequate water supply for a growing inland town is always an interesting procedure and if the town in question happens to be situated over formations in which a ground water supply is impossible, the solution of the problem is sometimes difficult and expensive. Horton, Kan., is an inland city with a population of approximately 4,500 and is a typical town of this class, with the exception that the Rock Island R.R. operates extensive shops which furnish an industrial demand for water which amounts to approximately 0.3 m.g. daily.

Previous to 1910 several small wells were used but

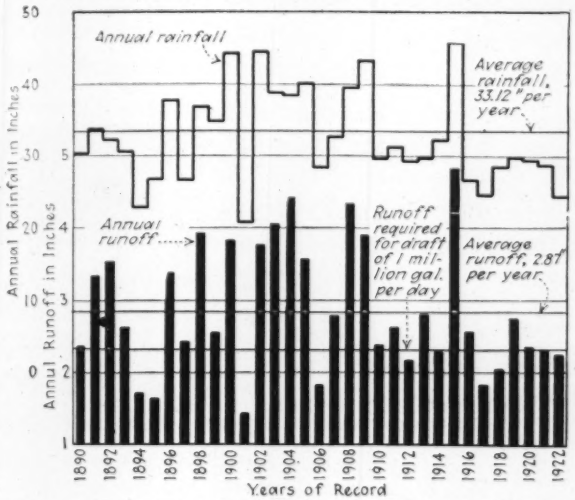


FIG. 1—RELATION BETWEEN RAINFALL AND RUNOFF, MISSION CREEK, HORTON, KAN.

they were never satisfactory and at that time extensive improvements were made which included a 12-m.g. storage reservoir into which the flood flow of Mission Creek was diverted through an 18-in. circular inlet, a 0.5-m.g. coagulating basin and a filter plant with two 0.5-m.g. units.

Lack of storage spelled failure for this supply from the start, and after suffering numerous water shortages the city in 1922 employed engineers to make a comprehensive survey of the water resources in the vicinity of Horton and to recommend the best method of providing a 1-m.g.d. water supply. This survey was made during the fall of 1922 and included the gaging and testing of numerous springs and wells, the sinking of 120 test wells and studies on five different drainage areas. It was in fact a complete canvass of the water possibilities for Horton. Following this survey, contracts were let in 1923 for an earth dam, a gravity pipe line to the existing purification plant, a new clear-water basin and new pumping and sterilizing equipment.

Impounding Reservoir—The dam site selected is on Mission Creek about 1,000 ft. above the point of diversion into the old reservoir, and since the same stream is used for the new supply, the only real difference is in the matter of storage. The dam impounds water from approximately 9 sq.mi. of farming country. The

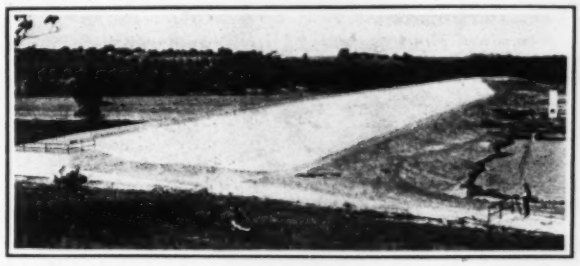


FIG. 2—GENERAL VIEW OF EARTH DAM, HORTON, KAN.

rainfall and runoff characteristics, as worked out from 33 years' available records, are given in the accompanying diagram which shows that with an average rainfall of 33.12 in. an average runoff of 2.87 in. may be expected, and that for a draft of 1 m.g.d., 2.32 in. or 81 per cent of this must be available.

The storage necessary for the 1 m.g.d. was taken from a "mass" or "Rippl" diagram platted from the monthly calculated runoff and was found to be 680 m.g. To impound this amount of water, a dam 1,170 ft. long, with a maximum height of 34 ft., containing 52,000 cu.yd. of fill, was constructed, and a lake which will cover 177 acres to an average depth of 11.8 ft., when filled, was formed. The dam has a crest thickness of 10 ft., slopes of 3 to 1 on the upper side and 2 to 1 on the lower side. The central 8 ft. are of puddled clay. Wakefield sheetpiling formed of three thicknesses of 3x10-in. plank extends from this puddled fill to rock or clay a distance of from 5 to 20 ft. The dam is paved on the upstream face for a vertical distance of 17 ft., or from 4 ft. above to 13 ft. below the spillway elevation. The paving is composed of 5x30-ft. slabs 4 in. thick in the center and 6 in. thick at the edges, laid longitudinally with asphalt-filled broken joints.

Spillway—A rock ledge at the east end of the dam made the "contour" type of spillway the most economical since the waste weir, which in this case is in the form of an ogee-faced dam 135 ft. long, has an excellent foundation for its entire length. The yardage of concrete in the spillway is 474, of which 180 cu.yd. is reinforced. The maximum discharge of the spillway at a head of 4 ft. is 3,600 sec.-ft., or approximately 400 sec.-ft. per square mile of drainage area.

Unit Prices—The unit prices of work in connection with the dam and spillway were:

Excavation for spillway	20c. per cu.yd.
Puddled clay in dam	40c. per cu.yd.
Earthwork in dam	30c. per cu.yd.
Reinforced concrete	$25.40 per cu.yd.
Plain concrete	12.60 per cu.yd.
Sheetpiling in place	127.00 per M b.m.
Loose rock excavation	1.00 per cu.yd.
Ledge rock excavation	2.00 per cu.yd.

Intake Tower and Pipe Line—A reinforced-concrete intake tower, with three 16-in. circular screened and valved inlets, was constructed and connected with the existing purification plant by means of a 12-in. cast-iron gravity pipe line, 2,400 ft. long, fitted with an automatic control valve at the lower end to maintain a constant level in the coagulating basin.

Purification Plant—The coagulating basin and filter plant constructed in 1910 are in good condition and were incorporated in the new system without change except for baffles and weirs in the coagulating basin

to provide for adequate mixing. A 167,000-gal. reinforced-concrete clear-water reservoir was constructed to replace the old brick well which leaked badly. Ultra-violet-ray lamps for disinfection purposes are located in the force main.

Pumping Equipment—A brick and concrete pump house 18x24 ft. in plan was constructed over the clear-water reservoir and motor-driven pumping equipment consisting of one 300-g.p.m. pump was installed. Power for pumping is obtained direct from the switchboard at the municipal power plant located a few feet away.

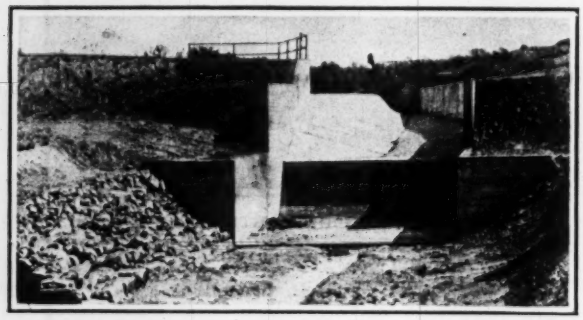


FIG. 3—SPILLWAY FOR EARTH DAM, HORTON, KAN.

All the engineering work for the new supply was handled by Black & Veatch, Kansas City, Mo.

City Saves 75 P. C. of 25-Year-Old Brick

WITH a number of its brick streets, laid some 25 years ago, needing reconstruction, the city of Jamestown, N. Y., has, with its own forces, done extensive reconstruction work during the past few years. In such reconstruction remarkable reuse is secured from old brick.

The best examples of reconstruction work are on streets occupied by surface car lines. About 15,000 sq.yd. of this work was done last year and in the following manner: The car tracks had been set on ties embedded in a 5-in. concrete base. All work was done with scarcely any traffic interference. New ties were put in and the track raised by ballasting under the ties with crushed slag or stone 2 in. above the curb height. The old brick were then taken out and cleaned. Because the work was done in warm weather men went to work cleaning the brick of pitch filler at 4 a.m.; when it became warm it was a slow job but easy so early in the morning.

In some places the old sand filler had crept so that it had piled 5 in. high, leaving many other places bare of the filler. Bumps and holes in the pavement had naturally resulted. Holes in the base were then filled and from 3 to 5 in. of new concrete was spread over the entire base, none of the old base being disturbed except to clean it where necessary. A 1-in. sand-cement cushion was then spread and brick laid. It was found possible to use 75 per cent of the old brick, with proper cleaning. The rest of the brick was further segregated and inspected and about 10 per cent sent to the storehouse for sewer materials where it is to be used in building manholes. Thus 85 per cent of the 25-year old brick is usable for reconstruction work. Asphalt filler was also used on the reconstruction. The work was done at an average cost (covering 12,500 sq.yd. on East Second St. and 2,500 on Windsor St.) of $2.35 per square yard.

Municipal Recreation Park Developed from Unused Tract

BY EDWARD H. PRENTICE
City Engineer, Binghamton, N. Y.

RECREATION PARK at Binghamton, N. Y., offers an attractive example of the small park development. The arrangement of the various features has been carefully studied and facilities are to be found there for a surprising variety of sports befitting all ages and inclinations.

Of the park area, over one-half is covered by a splendid stand of oak trees. This wooded section is subdivided into three smaller areas by broad asphalt pathways which lead in from entering streets at the sides of the park. These pathways join in a circular way which surrounds the bandstand, the central feature of the park. One of these smaller areas is set apart for a children's playground; another for picnic purposes and the third for a carrousel and service building.

WADING POOL, RECREATION PARK, BINGHAMTON, N. Y. Funds for this pool were subscribed by school children of the city. The service building of the park appears beyond the pool.

The service building is located on the longitudinal axis of the football field and is surrounded by shrubbery and lawns. In this building are provided locker and shower rooms for both men and women as well as a superintendent's office and storage rooms. Flanking the building are croquet grounds and a putting green.

The open area of the park was originally a rather steeply sloping field, which now is formed into three terraces. The upper terrace is a lawn treated formally with flower beds and pathways. This treatment features a statue of Mr. Johnson, erected by the citizens of Binghamton, and a flag pole, presented to the city by Post 80 of the American Legion.

On the second terrace is located the football gridiron, the slope of the ground between the first and second terraces being utilized in the erection of a concrete stadium. On the third and lowest terrace are arranged a baseball diamond, eight tennis courts and a parking space for automobiles. For winter use the football field is flooded for skating and a large portable three-chute toboggan slide is built on the slopes of the three terraces.

In a period of three years an unsightly tract has been transformed into a resort of utility and beauty, appreciated and enjoyed by the people of the community.

Moving Forms Used on Framed Concrete Building

Concrete Placed in 1-Ft. Stages on Column, Beam and Girder Part of New B. & O. Grain Elevator—Central Concreting Plant—Flexibility in Grain Handling Equipment

By J. O. B. Coulling
Engineer, M. A. Long Co., Baltimore, Md.

On construction of the new 3,800,000-bu. terminal grain elevator just completed at Locust Point, near Baltimore, Md., for the Baltimore & Ohio Railroad Co., it was proved conclusively that the moving-form method of forming concrete can be successfully applied to reinforced-concrete buildings of the beam and girder, daylight factory type of construction. The advantages of this type of form have long been recognized and it has been used extensively in grain elevator work. Cupolas have been built in this manner before but there was always a great deal more concrete in the structure, the windows taking up a small area in comparison with the window area in this particular cupola, which in reality is a skeleton framing of columns, beams and girders, as may be seen in Fig 1.

General Features of Design—The cupola is that part of the working house above the bins, as shown in Fig. 2, containing the upper portion of the legs, the large hopper scales, scale garners, transfer belts and the fixed and movable spouting, comprising the equipment necessary for elevating, weighing and distributing the grain. At the top of the bins, 103 ft. above the track level, the cupola is 61 ft. wide by 240 ft. long. These dimensions are maintained for the height of one story, a distance of 18 ft. At this point, one row of panels, 15 ft. wide and extending the full length of the structure, is omitted, leaving a building 46x240 ft. This necessitated stopping the moving form at this point, cutting loose the part for the discontinued panels, and rebuilding an entire side. The dimensions 46x240 ft. are maintained for the remaining 85 ft., the total height of the structure being 206 ft. above the track level.

The bays are 15 ft. and 15½ ft. wide by 16 ft. long; the maximum column width is 3½ ft. The windows extend from column to column and the full height of the stories, except for a 3½-ft. curtain wall and the beam above, the average size of window being 12½ ft. wide by 10½ ft high. In addition to the windows, there are several openings for rolling steel doors where channel guards and angle sills were set in place as the form went by. Complete channel door frames were also set in the stair well and elevator shafts. In the interior of the structure, all spaces under beams and girders had to be blocked out. The columns are octagonal in shape and are located above the contact points of the bin walls. In the story immediately above the bins, the areas of the columns are considerably greater than those of the bin contacts, the loads being distributed to the bin walls. The sizes of the columns above this story are decreased at each floor to provide an economical design. These changes are readily made in the moving form.

Design of Beams and Floor Slabs—All beams and girders were poured as the form was raised and are of the same thickness as the corresponding walls below. They were designed as rectangular beams and were stopped off at the elevation of the bottom of the

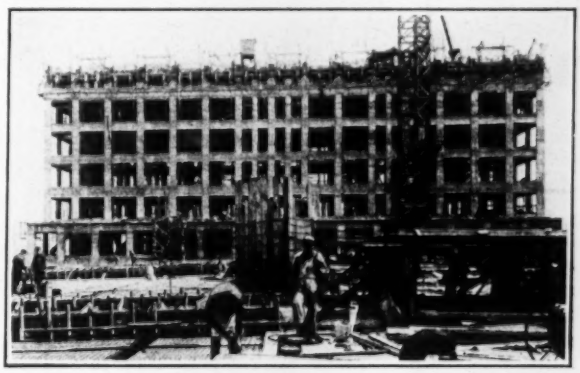


FIG. 2—WORKING HOUSE CUPOLA VIEWED FROM ROOF OF STORAGE
Moving form part way up.

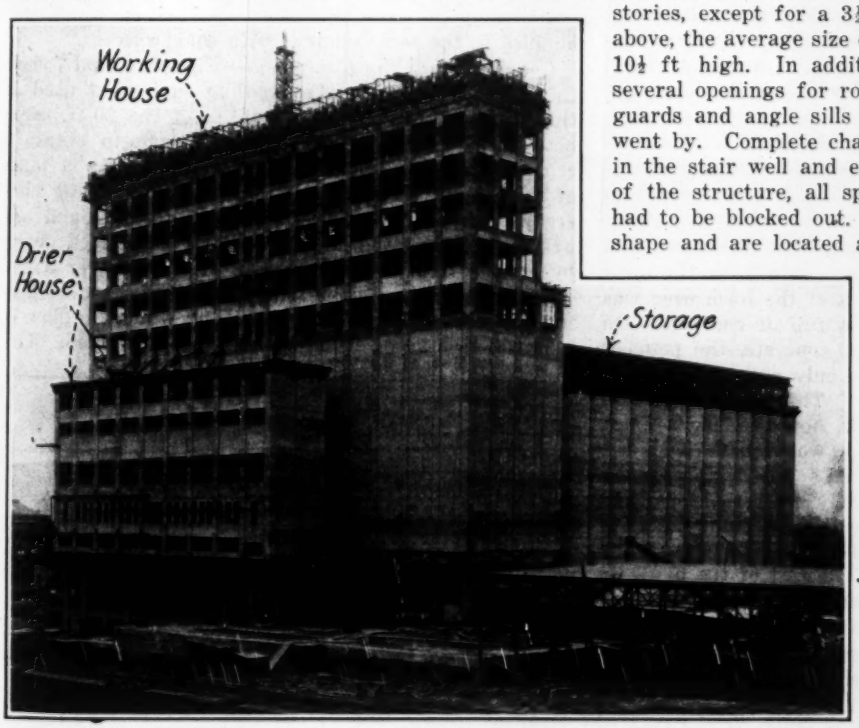


FIG. 1—NEW B. & O. GRAIN ELEVATOR AT BALTIMORE
View shows concreting practically completed, with moving form at top of working house cupola.

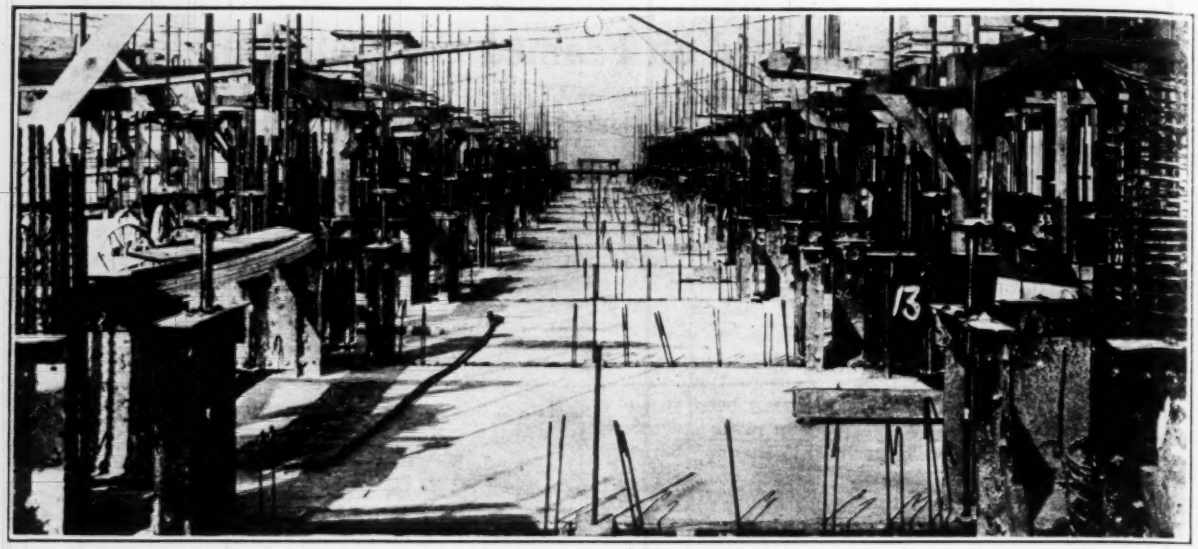


FIG. 3—WORKING DECK OF WORKING HOUSE MOVING FORM

floor slab. The bent reinforcing bars were not carried above this point, but the stirrups were extended above and embedded in the floor slabs. No bond was considered to exist between the slabs and the beams. After the moving form had passed a floor, work was immediately started on the fixed forms for the floor slab, these being supported on timbers resting in pockets left in the beams and walls. Grooves, 2 in. deep and the height of the slab thickness, were provided in the wall beams for receiving the floor slabs. At the roof, the moving form was secured by bolts set in the concrete and the working deck used for the roof form.

Moving Forms—From the above description and Figs. 1 and 2, it will be readily seen that this structure is similar in every respect to the usual well lighted warehouse or factory, the amount of concrete used being the minimum to insure structural safety. In addition, the great height of the cupola would have made the handling of heavy form panels extremely expensive and dangerous, with the possibility of a whole story of fixed forms being wrecked by a wind storm before depositing concrete. The use of the moving form eliminated this danger as only a small surface was exposed to the force of the wind. The vertical height of the form used was 4 ft., 3 ft of which was always full of concrete. On account of the small amount of concrete, the pouring was carried on in the daytime only and not continuously as in the case of the bins. This had no effect on the appearance of the structure, however, for a much better finish was obtained than would have been the case had fixed forms been used. All surfaces were given a rubbed finish immediately after the form had passed, continuous scaffolds being hung from the moving form for this pupose. The average rise for a 10-hour day was 3 ft.

Because of the size of the openings, it was impossible to arrange the jacking bars so that they could be embedded in the concrete for the entire height; they therefore had to be carried through the window openings and interior blockouts. Practically every jacking bar had to be handled in this manner, which meant that in all openings these bars had to be braced by means of heavy timbers and bolts to prevent deflection. After the form had reached the top, the portions of the jacking bars extending through the openings were burned off.

A substantial saving over the estimated cost of fixed forms was effected by the use of the moving form, although there was previously much discussion as to the advisability of its use. A shorter construction period was required and, taking everything into consideration, this method of construction is thoroughly adaptable to this class of work.

Fig. 3 shows the working deck of the working house moving form. Fig. 4 shows the drier house, a smaller building of the same skeleton construction, which was handled in the same manner with equal success.

Concrete Handling Equipment—Figs. 5, 6, and 7 show the layout of the concrete handling equipment used on this project. Advantage was taken of the 20-ft. space between the working house and storage to obtain a central location, which is always desirable in a plant of this kind. Two 1-yd. electrically driven tilting mixers were used at the bases of two towers. Sand and gravel were received in carload lots, and placed partly by gravity and partly by locomotive crane over a belt conveyor tunnel. Hoppers and gates were provided at intervals in the top of the tunnel, by which the flow of material to a 24-in. belt conveyor was controlled. This

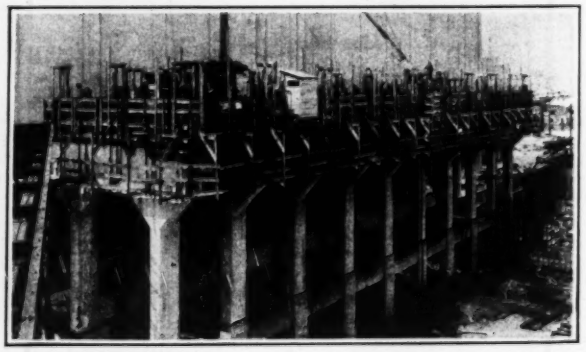


FIG. 4—DRIER HOUSE MOVING FORM A FEW FEET ABOVE STARTING POINT

conveyor, which extends the full length of the tunnel, ran up an inclined trestle and delivered the sand and gravel to the storage bins over the mixers. It had a speed of 350 ft. per min. and a capacity of 180 tons per hr. The sand bins had a capacity of 20 cu.yd. each and the gravel bins 40 cu.yd. each. Cement was received in bags in carload lots and stored in a shed on the opposite side of the mixing plant from the sand and gravel storage. It was taken to the mixers in bags by a 20-in. belt conveyor having a speed of 200 ft. per min. This arrangement was thoroughly satisfactory. Out of a total of 55,000 cu.yd. of concrete, 40,000 cu.yd. were poured in 100 consecutive working days. This was during the period when the moving forms for the storage and working house were being raised simultaneously.

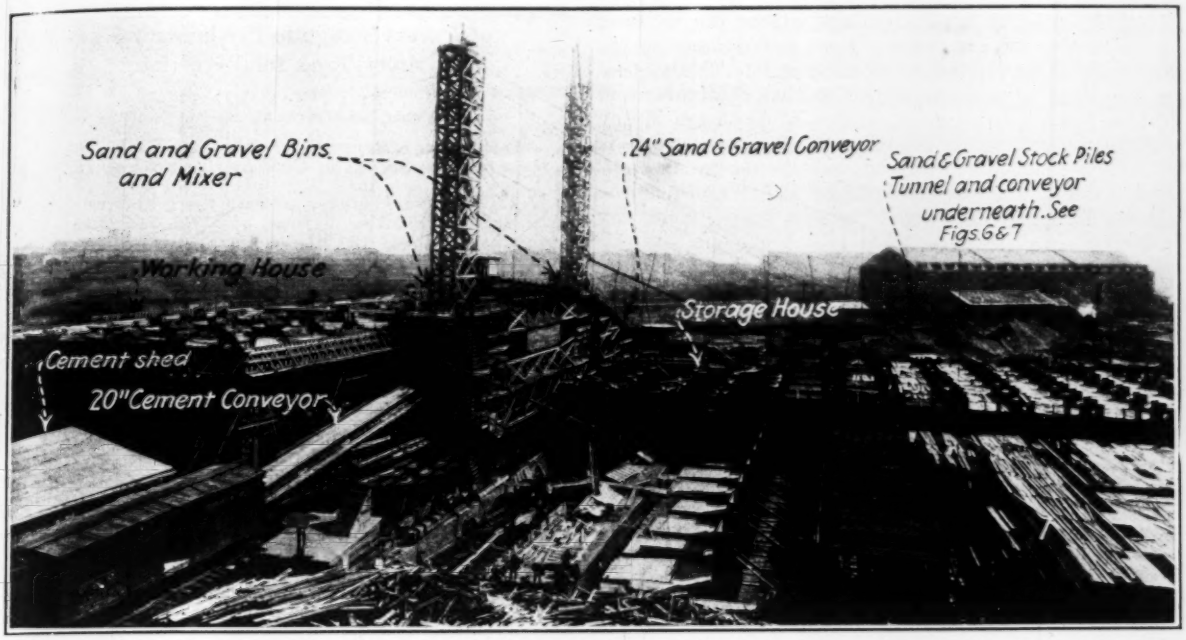

Sand and Gravel Bins and Mixer
24" Sand & Gravel Conveyor
Sand & Gravel Stock Piles
Tunnel and conveyor underneath. See Figs. 6 & 7
Working House
Storage House
Cement shed
20" Cement Conveyor

FIG. 5—GENERAL VIEW OF CONCRETE HANDLING PLANT ON B. & O. GRAIN ELEVATOR
A 20-ft. space between the working house and storage provided the site for the central mixing plant.

Operating Plan and Equipment—The car unloading equipment, consisting of four dumpers, is an interesting feature of the design of this elevator. The platform of the dumper, when not in use, is supported on the concrete substructure of the car dumper shed. While unloading a car, the platform and car are tilted and rocked by cables running over drums located overhead, electrically operated, and controlled from below. As the car is tilted, the grain door is pushed open so that when the car is rocked the grain flows out of the side door into a receiving hopper below from which it is taken by a belt conveyor to a receiving leg in the working house. Each dumper is capable of handling 8 cars per hour, and each receiving belt and elevator 25,000 bu. per hour. The combined receiving capacity of the four dumpers is 256 cars (about 800,000 bu.).

An interesting feature is the unit system of operation. The working house, although one structure, really comprises four complete operating units, each capable of receiving, weighing, cleaning,

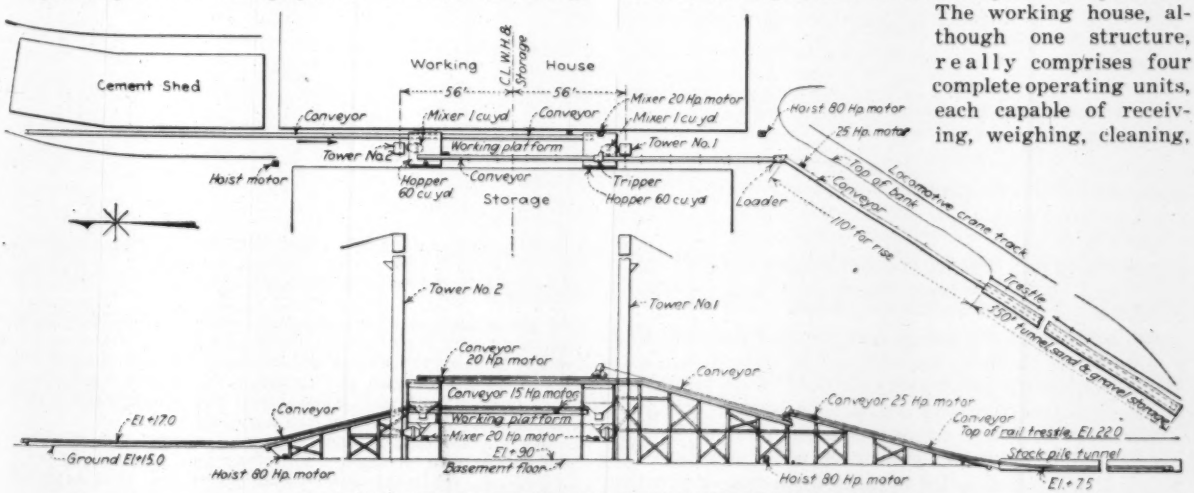


FIG. 6—PLAN AND ELEVATION OF CONSTRUCTION PLANT
Conveyor belts brought materials to mixer at foot of towers. Note tunnels carrying conveyor belt under sand and gravel storage.

drying, storing and shipping grain. The drier house, though separated from the working house for reasons of fire protection, is really a part of this structure and the driers are so arranged as to fit into their respective units, grain being spouted directly from the working house to the drier garners. Each car dumper is the beginning of one of these operating units. This method of operating is believed to be the best obtainable and insures the minimum delay in case of breakage in any part of the operating equipment. If, however, it is desired to depart from this method, the designing engineers have so planned the equipment that grain can be delivered from any dumper to any scale; from any

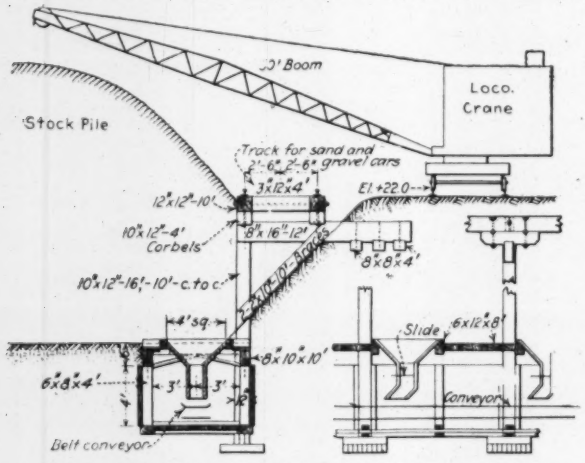


FIG. 7—DETAILS OF SAND AND GRAVEL STORAGE FOR GRAIN ELEVATOR AT BALTIMORE

Sand and gravel placed over conveyor partly by gravity from cars on overhead trestle and partly by locomotive crane.

scale to any bin in the working house or storage; from any scale to any drier unit; from any storage bin to any shipping bin in the working house. Direct access is provided from any shipping bin to any one of the six shipping belts leading through the shipping galleries to the piers; from any of these belts, the grain can be delivered to any dock spout for loading ships. In other words four main channels for the flow of grain through the elevator have been provided. Thus great flexibility is the theme of the whole operating design.

This elevator is the first to conform in every respect to all the requirements of the National Board of Fire Underwriters for the prevention of dust explosion. An efficient method of immediate dust removal has been provided and also a thermometer system for giving accurate information as to the temperature of the grain in the storage bins.

Personnel—This elevator was designed and constructed under the direction of the engineering department of the Baltimore & Ohio Railroad Co., H. A. Lane, chief engineer; L. P. Kimball, engineer of buildings; Richard Mather, district engineer; and J. C. Little, Jr., and Lee Hauser, field engineers.

The plans and specifications were prepared by the John S. Metcalf Co., Chicago, and the car unloading equipment is of the type designed by that firm. L. A. Stinson, consulting engineer, acted as consultant.

The construction was carried on under the direct supervision of M. A. Long, president, and G. E. Carlstrand, chief engineer, of the M. A. Long Co. The construction was handled by J. S. Johnson. The writer was assistant to Mr. Carlstrand.

Disposal of Excess Activated Sludge by Digestion

Experiments in the Ruhr District Indicate Return of Excess Sludge to Preliminary Two-Story Tank for Digestion

By Dr. Karl Imhoff
Engineer, Ruhrverbund, Essen, Germany

Abstract of a Paper Before the New York Section of the American Society of Civil Engineers, May 20, 1925.

IN THE activated-sludge process there are two kinds of sludge that must be disposed of: (1) The sludge of the preliminary tanks, (2) the excess activated sludge (see upper part of Fig. 1). Sewage plants in the Ruhr district, Germany, pay special attention to the removal of the excess activated sludge, which is done in the same manner as the other sewage sludge; that is, by decomposing it in digesting tanks, by making it fit for drying and by capturing the gases. The decomposed sludge is then dried on drying beds. To decompose organic sludge quickly and odorlessly and in small chambers, three conditions are essential: (1) Time (capacity), (2) warmth, and (3) inoculating and mixing. These conditions are interdependent, that is, the better conditions (2) and (3) are made, the shorter may be the time (condition) or the less the capacity required. Decomposition increases with the temperature. It is therefore essential that the decomposing tanks should be kept warm, which is best done by means of two-story tanks, using the warm flowing sewage itself.

Inoculation and mixing of fresh sludge with decomposing sludge applies especially to activated sludge, which, when left to itself, decomposes very slowly. Fig. 2 shows three sludge samples, of different composition, that have stood for six days. Glass 1 contains activated sludge, disinfected. Glass 2 contains ordinary activated sludge. In both these glasses there is no sign of decomposition. The sludge, however, has separated clear water on the top of the glasses and has almost reduced to a third of its original volume within four days. Glass 3 contains activated sludge, inoculated with 10 per cent digested sludge from the preliminary two-story tanks. This sludge has likewise separated water but has, at the same time, developed gases by decomposition which have caused it to rise in the water. The water has also become darker.

The two conditions, warmth and inoculation, are most conveniently brought about by pumping the excess activated sludge into the influent of the preliminary two-story

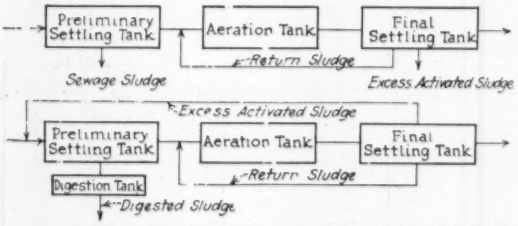


FIG. 1—ORDINARY COURSE OF EXCESS SLUDGE AND COURSE WHEN SENT TO DIGESTION TANK

tanks, as shown in the lower part of Fig 1. Four questions will now be answered:

1. What is the composition of the gas? The gases from the activated sludge are practically of the same composition as those from the sewage sludge, provided that they have been inoculated with digested sludge.

2. How large is the quantity of the gases? The quantity of gas, derived from the preliminary two-story tanks, amounts to 8 liters (2 g.) daily per capita. This quantity is doubled by the excess of activated sludge, that is to 16 liters (4 g.) of gas per capita. The power contained in this quantity of gas is so large that it probably would suffice for the working of the aerating tanks.

By experiment, it has been proved that the mixing of activated with sewage sludge has the advantages shown in Fig. 3. This shows the quantity of gas that originates from 1 kg. of organic matter at a temperature of 17 deg.

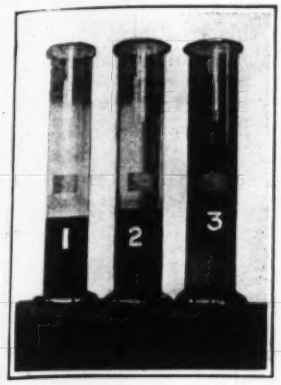


FIG. 2—ACTIVATED-SLUDGE SAMPLES AFTER SIX DAYS

1. Disinfected. 2. Ordinary. 3. Inoculated with 10 per cent digested sludge from preliminary two-story tank.

C., taken during an observation period of 70 days, from four different kinds of sludge mixtures. Activated sludge by itself produced the least quantity of gas, only 25 liters of gas. The other three sludge mixtures produced about 250 liters each. Notwithstanding this, there is a great difference in the intensity of the gas development, if the first 30 days are taken into consideration. The poorest result is from the sewage sludge (1 part of fresh sewage sludge and 1 part of the digested sludge) which produced after 30 days only 125 liters of gas. The activated sludge (one part activated sludge and one part of digested sludge) comes next with 160 liters for the same period, but the best result comes from a mixture of the three kinds of sludge namely 0.5 p. of activated sludge, 0.5 p. of fresh sewage sludge and 1 p. of digested sludge. This mixture has already produced 220 liters of gas after 30 days, that is to say, as much as the mixture of sewage sludge and digested sludge without the activated sludge in 60 days.

3. How large is the quantity of sludge? In Germany city sewage from a combined system produces about the following average quantities of sludge:

	Liters per Capita per Day	Per Cent Water
Fresh sewage sludge	0.6	95
Digested sewage sludge	0.2	80
Excess activated sludge	2.5	98
Digested activated sludge	0.16	80
Total digested sludge	0.36	80

From Fig. 4 it will be seen that the quantity of digested sludge of a two-story tank is increased by excess activated sludge from 0.2 to 0.36 liter per capita per day, and is therefore nearly doubled. At the same time, the quantity of the activated sludge is reduced from 2.5 to 0.16 liters per capita per day or to one-sixteenth the original quantity, which is an important result, especially if the activated sludge has to be carried away.

4. What size is necessary for the sludge digestion chambers of the two-story plants? In Fig. 4, above the horizontal line, is shown the capacity required for the preliminary digestion tank alone. This applies to German

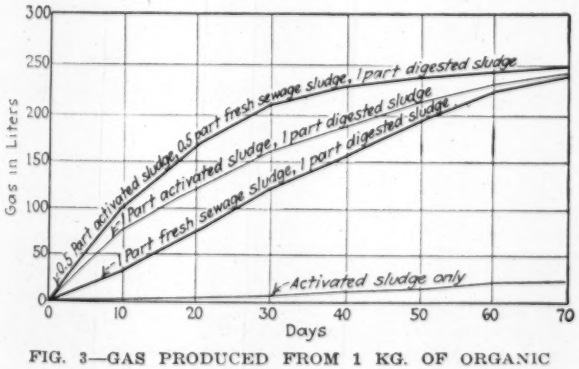

Gas in Liters
Days
0.5 Part activated sludge, 0.5 part fresh sewage sludge, 1 part digested sludge
1 Part activated sludge, 1 part digested sludge
1 Part fresh sewage sludge, 1 part digested sludge
Activated sludge only

FIG. 3—GAS PRODUCED FROM 1 KG. OF ORGANIC MATTER KEPT AT 17 DEG. C.

cities having no trade waste, and a yearly mean temperature of the sewage and of the sludge digestion tank as 12 deg. C. The required time of digestion, as shown, is three months. The water content of the fresh sludge, 95 per cent as it enters the digestion tank, is reduced during that time to 80 per cent, as shown by the upper curve in Fig. 4. The space between the curve and the solid horizontal line indicates the required capacity of the sludge tank, 30 liters per capita.

The question then arises: How much is the capacity of this sludge tank to be enlarged, if sewage sludge as well as excess activated sludge has to be decomposed therein? For this purpose is shown, under the horizontal line in Fig. 4, a curve indicating the reduction of the activated sludge, the water content of which reduces from 98 to 80 per cent. This sludge has already reached a water content of 91 per cent after seven days. The curve then takes a course similar to the upper one. The space between the lower curve and the solid horizontal line indicates the sludge space required for the activated sludge, only 20 liters (5 g.) per capita. In the case under consideration, the sludge tank will have to be enlarged from 30 liters per capita to 30 + 20 = 50 liters (12.5 g.) per capita if the activated sludge also is to be treated. It is possible that in large plants the data would work out more favorably, for the mixing of the activated sludge with sewage sludge

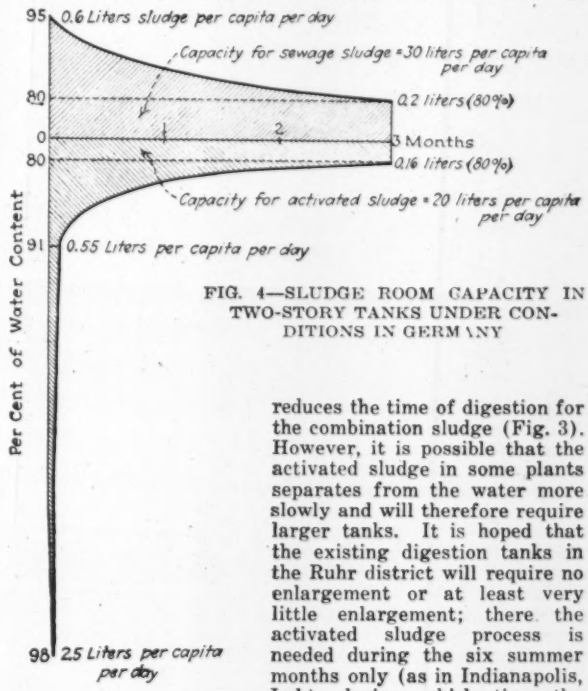


FIG. 4—SLUDGE ROOM CAPACITY IN TWO-STORY TANKS UNDER CONDITIONS IN GERMANY

reduces the time of digestion for the combination sludge (Fig. 3). However, it is possible that the activated sludge in some plants separates from the water more slowly and will therefore require larger tanks. It is hoped that the existing digestion tanks in the Ruhr district will require no enlargement or at least very little enlargement; there the activated sludge process is needed during the six summer months only (as in Indianapolis, Ind.), during which time the digestion brought about by higher temperatures is so much advanced as to create a surplus of available capacity for the activated sludge.

Unfortunately the data here given have been ascertained at an experimental station only (the large plant for 40,000 inhabitants at Essen is not yet completed) and can therefore not lay claim to being authentic for larger works. In any event it may well be maintained that the excess of activated sludge can economically be disposed of by taking it to the two-story preliminary settling and digestion tanks.

Buffalo Garbage Piggery Closed

The piggery at which the garbage of Buffalo, N. Y., was fed to pigs for several years, was closed late in April after several postponements of the date a court injunction to that end was to go into effect. The injunction was obtained by one of the Tonawandas, in which the plant was located. At first the piggery was operated under a contract providing that the city should receive a price for its garbage, delivered, varying with the price of live hogs on the Chicago market. Post-war conditions led the contractor to turn the piggery over to the city, which has operated it ever since, pending the provision of what it considered to be a more permanent means of disposal. Until the latter is accomplished the city is to get rid of the garbage as best it can.

walls, as shown in Fig. 1. For this hoisting a single 80-ft. gin pole was used, composed of two Douglas fir sticks 16 x 16 in. and 40 ft. long, spliced with long steel angles and channels.

The architects who designed the Ogden union station were John Parkinson and Donald B. Parkinson, Los Angeles, Calif. The H. W. Baum Co., Salt Lake City, Utah, was the contractor, with Ernest Hoffman as superintendent of construction.

Oxyacetylene Cut Does Not Injure Ductility of Steel

Bend Tests Show Good Results With Hacksaw, Milling Cutter and Flame—Steel Damaged by Shearing

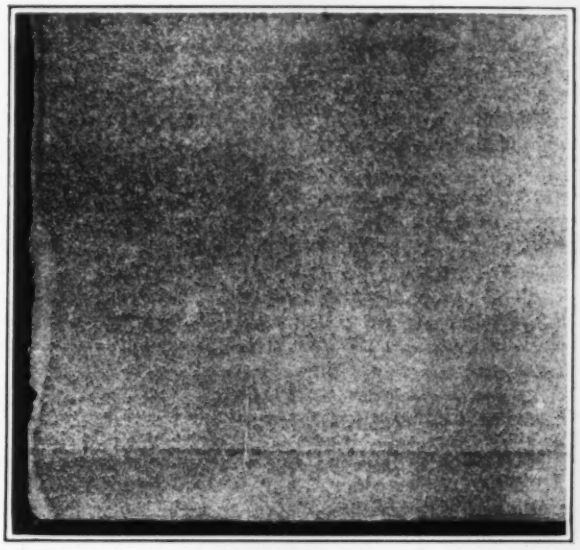
TESTS to determine the effect of oxyacetylene flame cutting on the strength and ductility of structural steel were recently made in the research laboratories of the Union Carbide & Carbon Co., New York City. The relative effects of hacksaw cutting, milling, flame cutting, shearing and friction sawing upon the metal adjacent to the cut face were determined. The experiments were undertaken because a state highway commission had taken an attitude against oxyacetylene cutting of structural steel for highway bridges. The results of the tests indicate that the flame cutting does not injure the metal, since both strength and ductility of the flame-cut surfaces were equal to those of milled or hacksawed surfaces. The following data are given by E. E. Thum, of the Linde Air Products Co., for which the experiments were made:

Square bars were cut from ⅜-in. structural steel plates, either one or both edges being cut by the method under test. They were then bent between bearing blocks spaced about 1 in. apart by a plunger with end rounded to a semicircle of ¾ in. diameter. In all cases the face cut by the method under test was on the outside of the bend. The table herewith gives the maximum load required in the bending, and the angle of bend at which cracking occurred; where 180 deg. is given, the full bend was made without cracking.

BENDING TESTS OF STRUCTURAL STEEL
To show effect of various methods of cutting

Material and Cutting Method	Maximum Load Required in Bending, Lb.	Maximum Angle of Bend, Deg.
Steel plate		
Machined	1,580	180
Cut with flame	1,670	180
Cut with flame, ⅛ in. of flame-cut edge then machined off	1,560	180
Sheared	1,250	37
I-beam web		
Machined	1,450	180
Cut with flame	1,625	180
Angle bar *A*		
Machined	2,510	72
Cut with friction saw	1,840	18
Angle bar *B*		
Machined	2,230	180
Cut with friction saw	1,500	29

Comparing the first four items in the table, it will be seen that three gave full bend without fracture, while the fourth specimen, which had a sheared edge, cracked at a small bend angle and showed low strength. Of the former three, the first bar was cut by hacksaw, the second with the oxyacetylene flame, and the third, after being cut oversize by the flame, was milled off ⅛ in. Comparing the second and third specimens, it will be seen that a slight hardening effect of the flame is indicated by the strength figures, while on the other hand the bend angle results indicate that the ductility was not affected. When the flame-cut face was milled off, the hardened metal was removed. The significant fact shown by these four tests is that the sheared bar was distinctly injured.



LOWER PART OF I-BEAM WEB CUT ACROSS WITH FLAME
Longitudinal section on center line of beam, polished and etched. The left-hand edge shows the effect of cutting the beam transversely with oxyacetylene flame. Deeper penetration of the flame effect at one point is due to double heating at this point from successive cutting of the two flanges. (About full size.)

Two tests made on bars cut from the web of an I-beam again showed satisfactory comparison with flame-cut and machined surfaces.

Four tests were then made on bars cut from a steel angle, to compare the effect of a hacksaw and of a friction saw. The two comparisons here obtained brought out a marked reduction of ductility resulting from cutting with the friction saw.

A picture of the shallow penetration of the flame effect under the surface of a cut face was obtained by photographing an etched section at right angles to such a cut face, as reproduced herewith. At the left in the picture the flame-cut face is indicated by a change in color, extending in most cases much less than ⅛ in., but some distance above the bottom flange about ¼ in. deep. In this middle portion the steel had been heated twice, once in cutting the flange on one side of the web and again on cutting the flange on the other side. The lighter colored metal at the flame cut corresponds to that which the bend tests showed to have full ductility, though slightly hardened.

Why St. Louis is Substituting New Boilers

The boiler plant of the Bissell's Point station of the St. Louis water-works is to be remodeled this year, it is expected, states E. E. Wall, commissioner of water supply, four new 500-hp. boilers installed, with up-to-date settings, superheaters, water softeners and soot blowers. The old plant was built in 1908 and while it might be used some years longer, Mr. Wall considers that a replacement will be more economical. An appropriation of $175,000 is available for the work.

Large Timber Roof Trusses in Ogden Union Station

Each Bottom Chord a 63-Ft. Stick—Trusses Exposed and Decorated—Erection Rig—Station Design—Special Brickwork

TO CARRY the roof over the waiting room of the new union station at Ogden, Utah, the architects adopted exposed wooden trusses built of exceptionally large timbers and designed as a modification of an early Italian type of roof with king-post trusses. Special study was given to the joints, the keys and daps of which are so located as to be concealed as nearly as possible by the heavy iron straps that fasten the members together. To conform to the original type, the connection blocks and end bearings have ornamental carving and all the woodwork is highly decorated in oil paint, the architects stating that in this treatment they followed the precedent of many churches of the late Middle Ages and the early Renaissance. The trusses in course of erection are shown in Fig. 1.

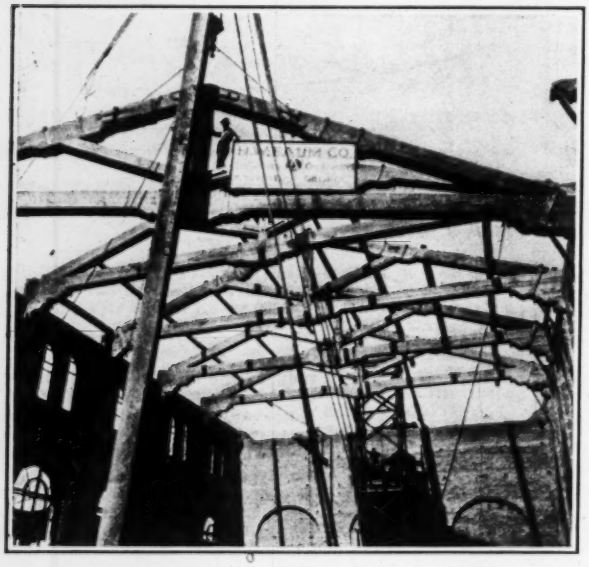


FIG. 1—PLACING TIMBER ROOF TRUSSES

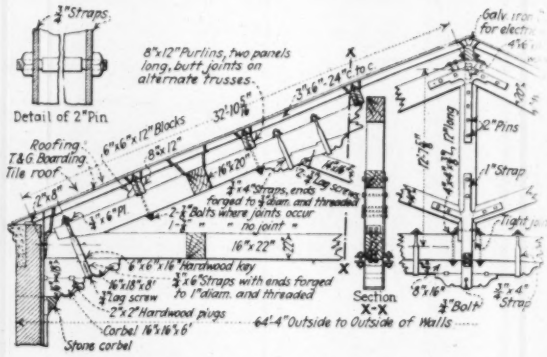


FIG. 2—TIMBER KING-POST ROOF TRUSS

Each truss has the bottom chord of the beam composed of a single Douglas fir timber 16 x 22 in. in section and 63 ft. long.; the top chords are sticks 16 x 20 in., 32 ft. long; king-post and diagonals are 14 x 16 in. These sizes were selected for the architectural effect rather than for actual load requirements. Heavy ornamented wooden corbels built into the brick walls support the shoe blocks at the ends of the trusses. Details of the truss design are shown in Fig. 2. Across the top chords are laid purlins 8 x 12 in. carrying 3 x 6-in. rafters spaced 2 ft. c. to c.; on these is laid 1-in. tongued-and-grooved plank sheathing covered with prepared roofing and then the outer covering of red Spanish tile. The waiting room is a lofty chamber 61 x 112 ft., with a clear height of 40 ft. 8 in. from the floor to the bottom chords of the trusses.

Erection of Trusses—Each truss was framed complete on the floor of the waiting room, lying on its side, the finished weight being about 10,000 lb. It was then hoisted and set with its end seated in recesses in the

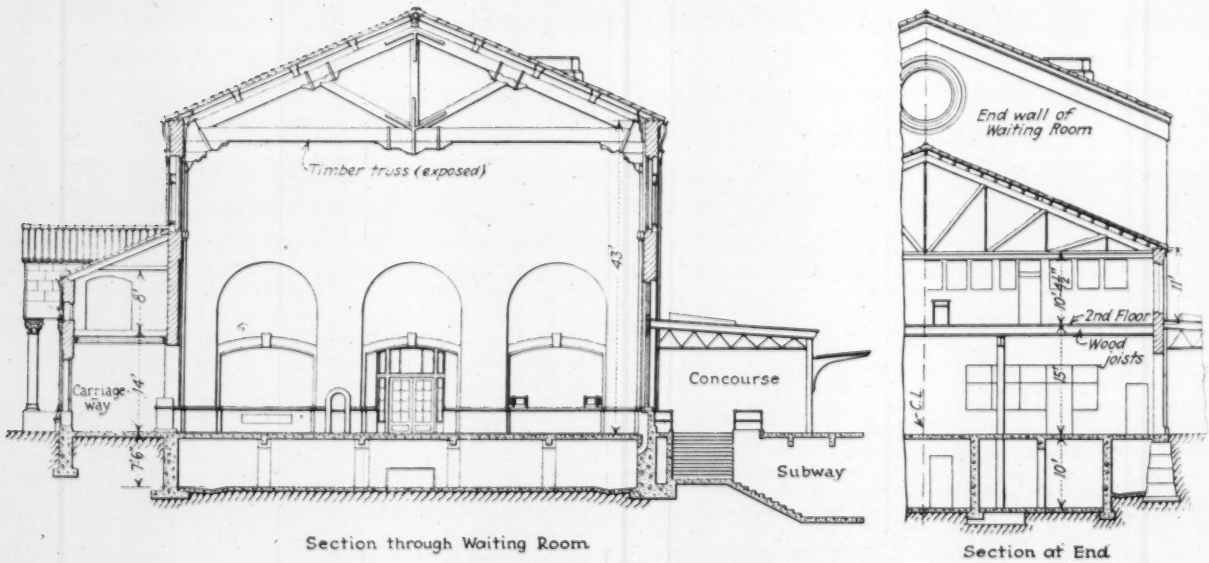


FIG. 3—CROSS-SECTIONS OF OGDEN UNION STATION

tain eminent authorities have questioned the existence of this relationship. These gentlemen are partly right for, if the matter is considered from the strictly scientific viewpoint, then the water-cement-strength relation should be applicable to any and all plastic mixtures of whatever materials, consistency and proportions; and this it is not. However, on any job the concrete engineer is interested only in a relatively narrow range of mixtures and for this the water-cement-strength relation holds with considerable precision. Extensive studies by the writer have satisfied him that for the usual variation of materials and range of consistencies permitted under modern specifications there is only a moderately small variation in strength for any one value of water-cement ratio and that if the proper water-cement ratio for the different strengths be determined for the average conditions of the job, these values are quite reliable unless a radical change in conditions occurs. The general relation stated by Abrams will be found to be reasonably accurate for average well-graded materials but where either very fine or very coarse sands are used it is well to check it experimentally, using these materials. Further, on work of considerable magnitude it pays to establish the water-cement ratio curve for the materials used, as Abrams' curve will ordinarily give such conservatively designed mixtures that an appreciable saving can be effected by working out the exact relation for that job. The expense of this experimental work should not exceed $200 in any commercial laboratory, an inconsiderable sum on any but the smallest of jobs.

"Fineness Modulus" Overemphasized—In a previous paragraph the writer referred briefly to the term "fineness modulus" which forms an important part of the Abrams method of designing concrete mixtures. Fineness modulus is a mathematical function derived directly from the sieve analysis of an aggregate which is claimed to be a measure of the concrete making properties of that aggregate. Its purpose is to furnish a means of predetermining the best mixtures of cement, fine and coarse aggregate which will give plastic concretes having the required water-cement ratio. It is unfortunate that so much emphasis has been placed upon this term because it has largely obscured the really fundamental principle upon which Abrams' method depends for its success, namely, the water-cement-strength relation; for, as said before, control of the relation of the cement and water in the mixture controls the strength of the concrete while the fineness modulus of the aggregate and the calculations therefrom are only of value to determine the most economic mix. It is of course desirable to determine this most economic mix but there are other mixtures having the required strength and workability and the determination of the most economic mixture is therefore not a problem of control of quality and should not be so considered.

That fineness modulus is not essential is borne out by the experience of the Hydro-Electric Power Commission of Ontario who have been pioneers in applying scientific methods of control on the job. For a number of years this organization has controlled the quality of both mass and reinforced concrete to a total of upwards of three-quarters of a million cubic yards by means of the water-cement-strength relation alone. In the method followed by them, control was obtained by limiting the quantity of water per bag of cement in the batch and by maintaining the concrete mixtures within a narrow range of workability. The proportions for the fine and coarse aggregate or the sand-gravel ratio were initially set after a consideration of the grading of the materials, the type of concrete, whether plain or reinforced, and the method of placing, while the water-cement-strength relation was determined experimentally in each case. With the sand-gravel ratio and the quantity of water per unit of cement set, a proportion satisfying the two conditions of workability and water-cement ratio was finally determined on the job by the method of trial and error.

This method has the advantage of simplicity and flexibility, it being possible to alter the sand-gravel ratio as field conditions show to be desirable without reference to the theoretical best combination of the aggregates. It also adapts itself to changes in the aggregate, for any changes of gradation sufficient to warrant a change in proportions will at once show up in the workability of the concrete mixture. To compensate for this it is only necessary to alter the quantity of cement and water in the batch at the same time, maintaining the proper ratio of water to cement until the desired workability is restored.

It should also be noted that this method complies fully with the theoretical requirement of the Abrams method of designing mixtures; for, according to the theories on which the fineness-modulus method is based, the fineness modulus of an aggregate depends on the gradation of the aggregate and is simply a measure of its concrete making qualities by which can be determined the quantity of cement and water required to give a concrete of a given strength or water-cement ratio at a certain workability of mixture. Therefore if, when the grading and consequently the fineness modulus of the materials change, the cement and water is varied until a mixture of the required workability and water-cement ratio is re-established, then, of necessity, the fineness-modulus theory has been satisfied whether the identical proportions which would have been obtained by following out the complete calculations of the method have been arrived at or not.

It should not be thought from the remarks about fineness modulus that the writer considers it to have no use; he merely believes that it is not an essential element in obtaining concrete of specified quality. Its place is in the determination of the best or most economic mixtures for the materials under consideration, and with the average run of materials, while it may not be perfect, it at least gives mixtures nearer the best proportion than the average engineer is apt to obtain by ordinary means. With unusual materials, such as very fine or very coarse sands, neither the fineness modulus nor any other general method of proportioning based on averaged results of many tests can reasonably be expected to apply. For all such cases experimental determination of the correct proportions is the only safe method.

Some Experiences in Control—The writer's own experience in controlling the quality of concrete may here be of interest. Six years ago on the first job where control methods were attempted, one of the scientific systems of proportioning was applied in full detail and with considerable measure of success. Since that time a more complete knowledge of the theories of concrete mixtures, of the variations occurring in the materials

Fundamental Factors in Concrete Quality Control

Practical Details To Be Considered In the Application of the Newer Theories of Proportioning

By R. B. Young
Assistant Laboratory Engineer,
Hydro-Electric Power Commission of Ontario, Toronto, Ont.

In his capacity as testing engineer for the Ontario Hydro-Electric Power Commission Mr. Young has had the practical problem of applying to the placing of hundreds of thousands of yards of concrete the results of the theoretical studies of the last ten years. This concrete has been placed over a wide area, with differing materials and for different uses, but it is of uniformly high quality. Few engineering officers have had so great an opportunity to study and apply scientific methods of concrete control, so the observations here given are of great practical value.—Editor.

THERE is of late an increasing interest in the subject of better concrete and a more general attempt to translate the results of the vast amount of recent experimental work into practicable field methods. Many have been deterred from making the attempt to use this new knowledge because of the complexity of the methods proposed and the apparent lack of agreement amongst the experts. Even those who have put the new theories into practice do not always seem to understand the principles which underly the methods they are using or the basic conditions necessary to good concrete. For these reasons it seems profitable at this time to restate the fundamental factors which govern the continuous production of a quality concrete.

In the first place it should be remembered that there are several steps in the production of concrete, all of which are important and none of which can be safely neglected, for no amount of attention to any one of these steps will guarantee good concrete if the others are ignored. These steps are:

Selection of materials.
Determination of the proportions which will meet the requirements of the design.
Measurement of the materials.
Mixing.
Placing.
Curing.

A detailed discussion of the selection of materials is outside the province of this paper. Almost any aggregate, clean, free from organic impurities and structurally sound, can be used in concrete irrespective of its gradation. There are important exceptions to this as where special properties such as resistance to high temperature, resistance to wear or watertightness are required, but ordinarily the selection of materials is governed by economic reasons and not by their ability when properly used, to make acceptable concrete.

Designing Properties—The second step is the design of the mixture. There are here two fundamental conditions which must be met. First, a concrete to be acceptable must meet the requirements of the service for which designed whether those requirements are strength, watertightness or resistance to wear, alkali or weathering. If, for instance, the designing engineer has specified a concrete having a certain compressive strength at 28 days it means that a concrete of that strength is necessary to the proper carrying out of the design and any less strength weakens, if it does not actually endanger, the structure. But the man who mixes and places the concrete is not usually so concerned with the properties of the finished concrete as he is with that immediately important property of the wet concrete, its workability. He requires above all things a workable mixture which can be handled and placed without undue labor and difficulty. Therefore the second fundamental condition in determining proportions is that the resulting mixtures be workable until after they are in their final resting place.

The problem then is to design a concrete mixture which will have the properties required by the designer of the structure and at the same time be workable when placed. There are several systems of proportioning claiming to do this and since it is customary for engineers to consider the quality of concrete in terms of its compressive strength, these methods, practically without exception, proportion mixtures on that basis. Of the several systems available, Abrams' fineness-modulus method is the best known and because of this and as it will serve to bring out the fundamental relationships underlying the practical proportioning of concrete mixtures, it alone will be discussed in any detail.

Applying Abrams' Method—Abrams has shown that for concrete workable when molded, the compressive strength is related to the ratio of water to cement in the freshly molded mixtures, or its water-cement ratio, each water-cement ratio having a corresponding compressive strength. This being true, it follows that if it is desired to obtain a concrete of a certain compressive strength, it is only necessary to know the proper water-cement ratio for that strength and to proportion the mixture of cement, aggregate and water to give a workable combination having that ratio.

Most methods of proportioning attempt to do two things simultaneously, first to proportion a concrete mixture having a specified strength and workability, and secondly, to determine the most desirable proportions of cement, fine and coarse aggregate for the materials available. Regardless of whether or not the most desirable combination of fine and coarse aggregate is obtained, concrete mixtures meeting a specified requirement for strength and workability can be had if the proper ratio of water to cement is not exceeded and sufficient cement and water in the correct ratio are used to bring the mixture to the required consistency. This point will bear repetition, as long as it is true that under the particular conditions of the job in hand a certain relation exists between compressive strength and the ratio of water to cement in the mixture, concrete of the desired strength and workability can be designed without reference to fineness modulus, surface area or any of the other formulas for proportioning, if this relation is known. Furthermore, it is immaterial whether or not the theories governing the use of these formulas are even correct nor is it necessary for the engineer to understand them; he can still design concrete mixtures with accuracy and maintain control over their quality, if he is prepared to accept the existence in a concrete of this relation between the ratio of water to cement and the compressive strength.

Many readers of this article will remember that cer-

Supreme Court Approves Trade Statistics Distribution

Majority Opinion Says that Trade Association Statistical Practice Should Be Judged by Effect on Production and Prices

A SWEEPING decision clarifying the legal view of trade association activities in gathering and distributing statistics was handed down by the United States Supreme Court June 1 when decrees of lower courts enjoining the Maple Flooring Manufacturers Association and the Cement Manufacturers Protective Association under the Sherman anti-trust law were reversed.

The decision was by a divided court, six to three. The majority opinion was delivered by Justice Stone, the newest member of the court, who, as attorney general, had given considerable study to the question of trade statistics at the request of the Department of Commerce. Justice McReynolds entered a vigorous dissent in each of the two cases on the ground that the tendency of the activities complained of by the government clearly was to enrich the members of the associations by controlling production or prices or both to the detriment of the consumer. Chief Justice Taft and Justice Sanford dissented in each case on the ground that the evidence brought these cases within the rule laid down by the Court previously in decisions sustaining decrees against the American Column & Lumber Co. and the American Linseed Oil Co.

The majority opinion, however, holds that in these previous cases clear intent to evade the law was established, while in the cases at issue now circumstances were different.

The principal decision was read in connection with the decree issued by the District Court in Michigan against the Maple Flooring Manufacturers Association, 22 corporation members, their representatives in the association and the secretary of the association. The association operates principally in Michigan, Minnesota and Wisconsin. There are 17 non-members making hardwood flooring also in this same territory and a total of 58 non-members in the industry in the United States, but members of the association represent 70 per cent of the production. The association gathered and distributed statistics of production, stocks, unfilled orders and average sales prices; it published a book giving railroad rates from Cadillac, Mich., to some 1,000 points in the country, and members held meetings where statistics and other matters were discussed. These things in themselves do not constitute restraint of trade, the majority opinion holds.

The Cement Manufacturers Protective Association operated along similar lines of gathering and distributing information. In addition, in this case the question of distributing information regarding specific job contracts was involved. The government sued in the District Court of Southern New York for an injunction, alleging violation of the Sherman law, and was given a decree. Justice Stone, for the majority of the Supreme Court, predicated his opinion in the cement case on that in the flooring manufacturers case, adding that information regarding specific job contracts was not violative of the law because it had not been established that contractors suffered but merely that the system protected manufacturers against contractors who might take advantage of such contracts for cement if the market was favorable. In this case, the association, four individuals and 19 corporations producing portland cement and operating principally in Pennsylvania, New Jersey, New York, Maryland and Virginia were involved.

Principles Stated—After reciting the history of the case, the majority opinion in the flooring manufacturers association case lays down broad principles as follows:

It is not, we think, open to question that the dissemination of pertinent information concerning any trade or business tends to stabilize that trade or business and to produce uniformity of price and trade practice. Exchange of price quotations of market commodities tends to produce uniformity of prices in the markets of the world. Knowledge of the supplies of available merchandise tends to prevent over-production and to avoid the economic disturbances produced by business crises resulting from over-production. But the natural effect of the acquisition of wider and more scientific knowledge of business conditions, on the minds of the individuals engaged in commerce and its consequent effect in stabilizing production and price can hardly be deemed a restraint of commerce or if so it cannot, we think, be said to be an unreasonable restraint, or in any respect unlawful.

It is the consensus of opinion of economists and of many of the most important agencies of government that the public interest is served by the gathering and dissemination, in the widest possible manner, of information with respect to the production and distribution, cost and prices in actual sales, of market commodities because the making available of such information tends to stabilize trade and industry, to produce fairer price levels and to avoid the waste which inevitably attends the unintelligent conduct of economic enterprise. Free competition means a free and open market among both buyers and sellers for the sale and distribution of commodities. Competition does not become less free merely because the conduct of commercial operations becomes more intelligent through the free distribution of knowledge of all the essential factors entering into the commercial transaction. General knowledge that there is an accumulation of surplus of any market commodity would undoubtedly tend to diminish production, but the dissemination of that information cannot in itself be said to be restraint upon commerce in any legal sense. The manufacturer is free to produce, but prudence and business foresight based on that knowledge influences free choice in favor of more limited production. Restraint upon free competition begins when improper use is made of that information through any concerted action which operates to restrain the freedom of action of those who buy and sell.

It was not the purpose or the intent of the Sherman Anti-Trust Law to inhibit the intelligent conduct of business operations, nor do we conceive that its purpose was to suppress such influences as might affect the operations of interstate commerce through the application to them of the individual intelligence of those engaged in commerce, enlightened by accurate information as to the essential elements of the economics of a trade or business, however gathered or disseminated. Persons who unite in gathering and disseminating information in trade journals and statistical reports on industry; who gather and publish statistics as to the amount of production of commodities in interstate commerce and who report market prices are not engaged in unlawful conspiracies in restraint of trade merely because the ultimate result of their efforts may be to stabilize prices or limit production through a better understanding of economic laws and a more general ability to conform to them, for the simple reason that the Sherman Law neither repeals economic laws nor prohibits the gathering and dissemination of information. Sellers of any commodity who guide the daily conduct of their business on the basis of market reports would hardly be deemed to be conspirators engaged in restraint of interstate commerce. They would not be any the more so merely because stockholders in a corporation or joint owners of a trade journal, engaged in the business of compiling and publishing such reports.

We do not conceive that the members of trade associa-

and conditions which must be met in concreting as actually carried out in the field have by their very logic forced him to simplify the methods of proportioning to include only the essentials already noted and caused him to view the problem of better concrete not as a problem of proportioning mixtures but as a skilled manufacturing process made up of a number of steps all of which must be controlled.

There is one point which comes up in the design of concretes no matter what methods are followed and that is they all design mixtures for strength, particularly for their 28-day compressive strength, and take no account of other desirable and needed qualities of concrete. For instance, the mere fact that a concrete has a compressive strength of 2,500 lb. per sq.in. is no guarantee that that concrete is either weather-resisting or watertight and consequently the design of concrete mixtures should not be based on strength alone unless strength is the only consideration. If other qualities are important it is not safe to be governed entirely by the proportions obtained by calculations and the engineer should make sure that the proportions set will give the other qualities desired.

As already stated, determining the mixtures is only one step in controlling the quality of concrete. It is important but of no more importance than are the measurement of materials, mixing, placing or curing. It is no more ridiculous to use seven figure logarithms to work up observations accurate to but three figures than it is to determine the proportions for concrete by one of the exact systems and then go into the field and use methods giving variations in quality of fifty per cent or more, yet that is what is being done when the proportions are determined by some precision method and the manufacture of that concrete carried out in the usual manner.

For instance, very precise methods of designing are certainly not justified unless accurate means of measuring are used for the materials going into the concrete. Ordinary volumetric methods of measurement are very inexact, variations of 15 or 20 per cent being common. Uniform concrete can not be had when such variations occur and uniform concrete is important not only because uniformity of product is desirable but because it is economical. For example on a large project of which the writer has knowledge the designing engineers allowed concrete of a lower grade to be used as soon as it was demonstrated in the field that concrete of a specified compressive strength could be consistently produced, and this resulted in a very considerable saving in cement as the yardage involved was large. On another work the use of accurate measuring equipment for the concrete materials not only resulted in considerable saving of cement due to closer proportioning but it also lowered concreting costs by increasing the output of the mixing plant, reducing the delays in handling and by making control easier.

There is really little excuse for the practice of volumetric measurements as ordinarily carried out. It is generally known to be very inexact and the means of remedying the matter are readily available. For stationary plants there is a choice of batchers, inundators and weighing equipment, any one of which will largely eliminate the variations, while for small portable plants it is not difficult to devise an economical means of accomplishing the same objects. On any but the smallest jobs the economies brought about by having a uniform concrete will justify the installation of such plant or methods independently of any justification due to having a concrete of better and more uniform quality.

The quality of concrete is not entirely determined by its proportions and the care with which they are measured in the field. Mixing must not be neglected nor should the methods of handling and placing be overlooked. The strength of concrete is probably not as adversely affected by undermixing and lack of care in handling as are other qualities. Insufficient mixing which lowers the strength possibly 10 to 15 per cent will make a mixture much more difficult to place properly through its increased tendency to segregate and segregation is a thing to be avoided. Most construction men feel that the worst feature of segregation is the patching and extra finishing required, but that is a mistake. Segregation is objectionable under any circumstances because among other things it means leaky structures where watertight concrete is desired, places of low strength perhaps in dangerous locations, increased laitance and a lowered resistance to weathering. Its effects can be hidden but never corrected, and if not wanted, it must be prevented. This requires thorough mixing, a not too wet consistency and care in handling and placing the wet concrete.

Another factor and a most important factor is the curing. If road concrete requires careful curing to obtain the desired strength and resistance to wear, why should other concrete be almost entirely neglected and left to chance? The only objection to proper curing proceeds either from the fact that it is not considered essential or from the idea that it will unduly slow up the job. The latter is not necessarily so but it does require those responsible for the concrete to give the curing the special attention it deserves.

Good concrete is a durable concrete which fulfils its proper functions with all necessary factors of safety provided for. It is not guaranteed by following any particular theory as to the selection of materials, methods of proportioning, etc., but is the product of forethought and intelligent care in respect to every detail of its manufacture. This means careful supervision, and the extra cost of this class of supervision can usually be more than offset by economies due to the resulting closer attention to detail but is in any case justified by the superior results. Experience shows its first cost need be no more than for poor concrete and its final cost, particularly for concrete exposed to the weather, will be less, for well made concrete is durable and poorly made concrete is not. Therefore it may be said that good concrete can be obtained at little if any increase in cost by methods simple, practicable and proved and involving no fundamental changes in present practice.

Competition for Recording Strain Gage Extended

A competition for recording strain gages and vibration recorders for bridges, announced by the German Railway Co. last fall (*Engineering News-Record*, Jan. 15, 1925, p. 118) has been extended, by notice just issued, from Jan. 1, 1925, to April 1, 1926. The prize total is 33,000 marks. The terms of the competition require the complete apparatus to be submitted, in condition ready for operation, so that it can be subjected to full tests, which may extend over several months. Detailed conditions of the competition may be obtained from the company's office, Berlin, Germany.

tions become such conspirators merely because they gather and disseminate information, such as is here complained of, bearing on the business in which they are engaged and make use of it in the management and control of their individual businesses; nor do we think that the proper application of the principles of decision of Eastern States Retail Lumber Association *v.* United States or American Column & Lumber Co. *v.* United States or United States *v.* American Linseed Oil Co. leads to any such result. The court held that the defendants in those cases were engaged in conspiracies against interstate trade and commerce because it was found that the character of the information which had been gathered and the use which was made of it led irresistibly to the conclusion that they had resulted, or would necessarily result, in a concerted effort of the defendants to curtail production or raise prices of commodities shipped in interstate commerce. The unlawfulness of the combination arose not from the fact that the defendants had effected a combination to gather and disseminate information, but from the fact that the court inferred from the peculiar circumstances of each case that concerted action had resulted or would necessarily result in tending arbitrarily to lessen production or increase prices.

Viewed in this light, can it be said in the present case, that the character of the information gathered by the defendants, or the use which is being made of it, leads to any necessary inference that the defendants either have made or will make any different or other use of it than would normally be made if like statistics were published in a trade journal or were published by the Department of Commerce, to which all the gathered statistics are made available? The cost of production, prompt information as to the cost of transportation, are legitimate subjects of inquiry and knowledge in any industry. So likewise is the production of the commodity in that industry, the aggregate surplus stock and the prices at which the commodity has actually been sold in the usual course of business.

We realize that such information gathered and disseminated among the members of a trade or business may be the basis of agreement or concerted action to lessen production arbitrarily or to raise prices beyond the levels of production and price which would prevail if no such agreement or concerted action ensued, and those engaged in commerce were left free to base individual initiative on full information of the essential elements of their business. Such concerted action constitutes a restraint of commerce and is illegal and may be enjoined as may any other combination or activity necessarily resulting in such concerted action. But in the absence of proof of such agreement or concerted action having been actually reached or actually attempted, under the present plan of operation of defendants we can find no basis in the gathering and dissemination of such information by them or in their activities under their present organization for the inference that such concerted action will necessarily result.

We decide only that trade associations or combinations of persons or corporations which openly and fairly gather and disseminate information as to the cost of their product, the volume of production, the actual price which the product has brought in past transactions, stocks of merchandise on hand, approximate cost of transportation from the principal point of shipment to the points of consumption, as did these defendants and who as they did, meet and discuss such information and statistics without, however, reaching or attempting to reach any agreement or any concerted action with respect to prices or production or restraining competition, do not thereby engage in unlawful restraint of commerce.

State Health Appropriation in Pennsylvania

Except for the department of public instruction, the state health department received the highest amount of any of the state departments of Pennsylvania in the appropriation bill for the next two years. The appropriations for these and a few of the other departments of most interest to engineers were: Instruction, $59,270,000; health, $4,620,000; forests and waters, $1,798,284; public service commission, $771,000; mines, $617,800; highways, $103,328.

Typhoid in Largest American Cities, 1924

EIGHTEEN of the 69 cities of the United States having populations in excess of 100,000 had typhoid death rates of 2 per 100,000 or less in 1924, according to the thirteenth annual typhoid survey of the *Journal* of the American Medical Association (Chicago, Ill.; March 14, 1925). An additional 35 cities, making 53 of the 69, had rates of 5 or less. Only 2 of the 69 had rates in excess of 15 per 100,000; Nashville, 20.4, and Memphis, 41.2, both showing high jumps from the 1923 rates. At the opposite extreme from these Tennessee cities were Fall River, Mass., and Hartford, Conn., with no typhoid deaths for the year and Worcester, Mass., with but 0.5 per 100,000. Trenton, N. J., which has been high for several years, fell to 0.8 in 1924.

TABLE I—TYPHOID DEATH RATES PER 100,000 IN 1924 IN THE 69 LARGEST AMERICAN CITIES

Honor Roll (from 0.0 to 2.0 Deaths per 100,000)—18 Cities			
Fall River	0.0	Rochester	1.2
Hartford	0.0	Oakland	1.3
Worcester	0.5	Springfield	1.3
Trenton	0.8	Chicago	1.6
Akron	1.0	Syracuse	1.6
Milwaukee	1.0	Fort Worth	1.7
Omaha	1.0	Lowell	1.7
Richmond	1.1	Louisville	1.9
Cleveland	1.2	Spokane	1.9
First Rank (from 2.0 to 5.0)—35 cities			
St. Paul	2.0	Seattle	3.2
Boston	2.1	Grand Rapids	3.4
Minneapolis	2.1	Bridgeport	3.5
Philadelphia	2.2	Kansas City, Mo.	3.6
Dayton	2.4	Paterson	3.6
Cincinnati	2.5	Columbus	3.7
Providence	2.5	St. Louis	3.7
Jersey City	2.6	Indianapolis	3.9
San Francisco	2.6	Pittsburgh	3.9
Newark	2.7	Tacoma	3.9
Yonkers	2.7	Washington	4.3
Baltimore	2.8	Los Angeles	4.4
Des Moines	2.8	Toledo	4.4
Buffalo	2.8	Cambridge	4.5
Scranton	2.8	Youngstown	4.5
Norfolk	2.9	New Bedford	4.5
Detroit	3.0	Kansas City, Kan.	4.6
New York	3.1		
Second Rank (from 5.0 to 10.0)—10 cities			
Denver	5.1	Portland, Ore.	6.1
New Haven	5.1	Camden	6.3
Reading	5.4	Birmingham	7.5
Houston	5.6	Dallas	8.2
San Antonio	5.8	Wilmington	8.3
Third Rank (from 10 to 20)—6 cities			
New Orleans	10.0	Atlanta	15.0
Salt Lake City	10.1	Nashville	20.4
Albany	12.6	Memphis	41.2

TABLE II—TOTAL AVERAGE TYPHOID DEATH RATE (1910-1924)

	Total Population (57 Cities)* Estimated by the U. S. Census Bureau Methods	Typhoid Deaths	Typhoid Death Rate per 100,000
1910	20,996,035	4,114	19.59
1911	21,545,014	3,391	15.74
1912	22,093,993	2,775	12.56
1913	22,642,972	2,892	12.77
1914	23,191,951	2,408	10.38
1915	23,740,930	2,068	8.71
1916	24,205,359	1,842	7.61
1917	24,740,068	1,647	6.65
1918	24,971,278	1,557	6.23
1919	25,525,186	987	3.87
1920	26,154,013	921	3.52
1921	26,561,469	978	3.68
1922	26,936,843	851	3.15
1923	27,365,408	851	3.11
1924	27,868,865	856	3.07

* Twelve cities of the cities in Table I are omitted from this summary because data for the full period are not available.

For the 57 cities for which data for the 15 years 1910-24 are available the typhoid toll fell from a total of 4,114 to 856 and the rate from 19.59 to 3.07.

The two main summary tables of the survey are reprinted herewith. The original article gives in addition the typhoid death rates of groups of states, arranged from greatest to least, presenting not only the 1924 rates but also those for the three earlier years and the averages for the three half decades 1910 to 1924.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

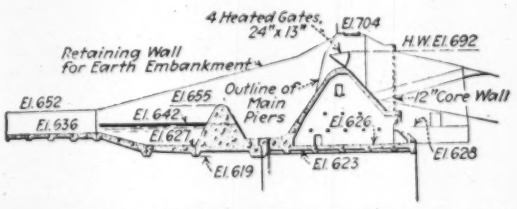
The Ogee Spillway Section Defended

Sir—The writer read with great interest the articles of Adolph F. Meyer in your issue of April 9, p. 597, entitled "High velocity discharge of overfall dams and forms of spillway profile."

Mr. Meyer is very sweeping in his denunciation of the ogee spillway profile. He speaks of "the well-nigh universal failure of that profile to perform its intended function" and states "that the ogee profile should have been almost universally accepted in the face of almost equally frequent initial failure to serve its purpose seems almost incredible." Very few hydraulic engineers will agree with these statements.

Although he does not say so, it is evident that Mr. Meyer's article refers only to soft ground foundations and has practically no application to firm rock foundations.

The purpose of the ogee spillway profile is to protect the dam itself and the foundation immediately under the dam from direct injury due to the impact of the falling water. When properly designed and constructed it has successfully fulfilled this function. If the material in the bed of the river readily erodes, it simply means that additional features should be introduced.



CROSS-SECTION OF MANISTEE RIVER DAM

For instance, with spillways on limestone foundations where the strata are approximately horizontal the writer knows of several cases where there has been considerable erosion downstream from the bucket where the bucket was placed at an elevation above the bed of the river. The trouble might have been obviated, and has been in many cases, by placing the bucket at an elevation considerably below the bed of the river and thus creating a pool to cushion the discharge from the dam.

In the case of spillways on soil and sand foundations the method shown in Mr. Meyer's Fig. 2 is effective if properly designed. As Mr. Meyer points out, there is a tendency for the spillway discharge to follow along the surface of the concrete apron under the relatively quiet water. Hence, means are frequently adopted to break up this tendency, either by the use of piers on the apron, the use of a second and lower dam, or by the use of a tumblebay.

Some engineers have successfully used a flexible concrete apron. Referring to Mr. Meyer's Fig. 2, such an apron would be divided up into heavy reinforced-concrete blocks, fastened together by means of cables or eyebolts. There would be no cutoff at the end of the concrete blocks. Beyond the end of the flexible reinforced-concrete block apron, the river erodes the sand or soil bed and backwash undermines the end of the concrete blocks, but these being flexibly jointed together sink into the hole thus formed. This process continues through several floods until finally a condition of equilibrium is established. The river has then dug a hole deep enough so that the water in it kills the velocity of the water discharged by the spillway to such an extent that its velocity is insufficient to pick up the particles of soil or sand.

In this connection it is worth while to recall an article published in *Engineering News-Record*, Sept. 12, 1918, p. 492, on the Junction Dam on the Manistee River, Mich. The spillway was founded entirely on soil, and its cross-section is here reproduced from the article mentioned. From the figure, it will be noted that the design combines the use of a flexible apron similar to that above described with the use of a tumblebay. Such tumblebays are very efficient in reducing the velocity of the water discharged by the spillway.

The tumblebay dam takes the sheet of water discharged by the spillway and turns it back on itself. The water then mills around in the tumblebay and then passes over the tumblebay dam at moderate velocity into the pool below. The Junction dam and spillway were designed and built by the Fargo Engineering Co. of Jackson Mich., which firm has constructed a considerable number of successful similar structures on sand foundations throughout the Middle West.

The writer mentions the above merely to indicate other means of solving the problem presented by Mr. Meyer and also to show that the undermining of spillways on soil foundations by backwash cannot properly be blamed on the ogee form of profile.

The use of a cushioning pool downstream from the spillway as indicated by Mr. Meyer in Figs. 3 to 9 is certainly very desirable with soft ground foundations and some method of mixing up the discharge water so that it will not flow along the apron or bed of the stream at high velocity is also essential.

However it would appear that there might be considerable objection to the use of the recesses shown near the downstream toe of the spillway in some of the figures. In some of these recesses there would, at times, be considerable areas where the pressure would be less than atmospheric. The structures could, of course, be designed to take care of this, but the vacuum effect on the concrete might be very injurious as a pronounced vacuum effect causes the rotting and disintegration of concrete.

The performance of actual installations designed along the lines suggested by Mr. Meyer will be watched with great interest.

JOEL D. JUSTIN.

Watertown, N. Y.,
May 2, 1925.

Destroying Energy Below Overflow Dams

Sir—I was interested in reading the article by Adolph F. Meyer in your issue of April 9, p. 597, on the subject of "High Velocity Discharge of Overfall Dams" inasmuch as the engineers of the Fargo Engineering Co. have for a number of years held similar views as to the desirability of destroying excess energy in the overfalling flood waters by causing the flood discharge to fall into a pool of water of appreciable depth before passing downstream through the flood channel.

In 1904 William G. Fargo designed a tainter gate spillway on the Muskegon River in Michigan, in which such a pool of water was formed downstream from the gate sills by the construction of a concrete weir at the downstream end of the base slab of the gate section, thus causing the flood water discharge to enter a pool of water of appreciable depth at a small angle from the vertical direction. In this manner a large portion of the excess energy was absorbed, and the flood water then passed over the crest of the downstream weir, which was at a lower level than the gate sills. The spillway channel below the weir was lined with concrete for some distance to prevent possible erosion of the river bottom, which in this particular case was alluvial material.

Mr. Fargo states that the design of this type of tumblebay below tainter gates was the result of a suggestion made by Lyman E. Cooley, and as far as we know this is the first instance of the use of this type of construction.

This design of spillway structure was very successful in operation, and since 1904 the Fargo Engineering Co. has designed and supervised numerous installations of similar type, largely in cases where the bottom of the spillway channel is of sand and gravel, clay or other soft materials. A number of these designs have been illustrated in the technical press, one reference which we can give being to an article [referred to also in Mr. Justin's letter—EDITOR] in the *Engineering News-Record* of Sept. 12, 1918, p. 492, which shows a section through the spillway of a 55-ft.-head tainter gate dam on the Manistee River in Michigan. In this installation it will be noted that in addition to the tumblebay formed immediately below the gate sills by means of a concrete weir, we also provided a second pool downstream from the weir, thus forming two bodies of

water into which the flood water discharged before passing down the spillway channel. From the bottom elevation of the lower pool a concrete apron slopes upward to meet the original depth of the river channel. This 55-ft. spillway is on a clay foundation.

A similar design of an earlier date is illustrated in *Engineering Record* of Aug. 31, 1912, p. 247. A pertinent reference to spilling water into a pool will also be found in Vol. LXII of *Transactions* of American Society of Civil Engineers, pp. 48 and 49, in a Discussion on Irrigation by Richard R. Lyman.

We trust that the above references will be found of interest in considering the matter of flood discharge as outlined by Mr. Meyer.

FARGO ENGINEERING CO.
By HORACE S. HUNT.

May 14, 1925.
Jackson, Mich.

Open Questions in Professional Ethics

Sir—To the engineer who has been engaged in independent practice for from ten to twenty years, the discussion of professional ethics is perhaps more interesting than it is to the engineer regularly employed upon municipal or corporation work, and no more interesting contribution to this subject has come to the writer's attention than that of D. B. Steinman and the editorial comment in *Engineering News-Record* of May 21.

As the editor intimates, mere generalities on ethical conduct will not serve to meet the multitude of questions on the border line between honor and dishonor which every practicing engineer must answer, and the specifications which Mr. Steinman has compiled are none too elaborate as an outline of the proper ethical practice between engineers. But what of the relation of engineer to client and to the public? Surely here is a field which needs careful charting and in no other field is the engineer more subject to judgment by his fellowmen.

Questions of ethics are usually insidious and seldom clear-cut, and it does not as a rule require deep reasoning to justify a course favorable to one's interest. Of course no reputable engineer would accept a secret commission in consideration of the placing of a contract, but how shall he look upon a substantial "present" from the contractor after the contract has been awarded? Of course no reputable engineer would render an inflated valuation of a public utility, but what shall be his attitude when both seller and buyer desire an inflated figure and threaten to summarily dismiss him if he does not meet the figures desired? Of course no reputable engineer would bear false witness, but why in so many water-power condemnation cases do the valuations of the two sets of experts differ in the ratio of as much as ten to one?

It must be apparent to any engineer who has had much to do with the trial of cases at court that sometimes neither side in an action desires "the truth, the whole truth and nothing but the truth." This fact was brought to the writer's attention several years ago when an engineer friend was engaged by the claimant in an important water-power condemnation suit. At a conference of engineers and attorneys previous to the trial of the case it was discovered that this engineer had estimated the damage to the water power by the public appropriation at about one-eighth part of the amount of the claim, and he was dismissed from the case. The attorney representing the other side promptly sought his services, and permission was given by the claimants for such change of allegiance. However when it was found that the figures of this engineer were double those chosen by the defendant, he was again dismissed.

There is competition among engineers in other ways beside price cutting and seeking engagements in unethical manner. There is competition in meeting the client's desire, however unreasonable it may be. The engineer who desires engagement as expert in court cases would do well to guard well the secret that he will approach the subject in debate with a fair and open mind and give only fair and impartial testimony.

An adequate code of engineering ethics would probably answer the question as to whether or not the engineering expert in court cases should constitute himself an advocate, and contribute his share to the quibble and evasion and partial truth which seems to be part of the legal game.

Discussion of engineering ethics is a good thing and any engineer who has kept up his technical reading and interest in his technical society should, by the time he is old enough to retire, not only have a knowledge of engineering ethics but have a will to apply them. But what is needed most, is an inter-association court of justice, a code of ethics with teeth, as the editor suggests, and a league to put it into operation.

H. B. SWEET,
Consulting Engineer.

Utica, N. Y.,
May 26, 1925.

Airplane Surveys and Pioneer Locating Engineers

Sir—Having until lately overlooked Mr. Wicksteed's letter of April 9, on Railway Surveys from the Air, I will not ask you for space in which, by argument, to reconcile my views with his, until we are on a common basis for comparing methods used by him with the mechanical process, which, I claim, eliminates the shortcomings of which he complains. To a discerning reader our divergence of opinion resolves itself largely into the questions of *what I thought he meant*, and *what he thought I meant*. The essential facts as to the value of the airplane on railroad surveys seem to have come through unscathed, and I am content to rest the case—time element, wooded gaps, altometer, and all—on Mr. Wicksteed's letter, to the glory of the aerial method.

The charge that I regard that truly gifted group of locating engineers of the past generation with contempt stings. I had the privilege of sitting at their feet, and my attitude toward their achievements, including those of Mr. Wicksteed, is one of pride, respect, and admiration. It is still logical to claim that modern methods tend to insure success for most of us, not so gifted, without implying criticism of their work. My boyhood enthusiasm for David's prowess against Goliath, with pebble and sling, is still going strong, after thirty-seven years. It is in no whit diminished by the fact that I prefer, and earnestly recommend, the employment of a high-powered Springfield and an extra pair of hand grenades for a similar job.

H. R. FAISON,
Mees & Mees, Engineers.

Hendersonville, N. C.,
May 17, 1925.

Contract Bonding Reform

Sir—I am interested in the editorial in *Engineering News-Record*, May 14, 1925, p. 797. Surely there are some, both in the contracting field and among the surety executives, who believe in building business on a sound and scientific basis. It seems to me that now is the time for men of this type to voice sound ideas on the subject of business conduct as applied to contract bonds.

It is my conviction that the responsibility for the evils and the ability to remedy them lie first with the executives of the surety companies and second with the responsible element among the contractors.

It is within the powers of the surety executive to relieve the contractors from being solicited for business in the disagreeable and obnoxious manner that has been disclosed not only in the Comptroller's investigation in New York City but also brought to the surface by the Bright investigating committee in the state of New Jersey. I have talked with some of the surety men and while admitting the existence of the evils and the desirability of correcting them, each one passes off the situation with a shrug of the shoulders and a deprecating remark, to the effect, "Well, what else can I do? If I don't play the game the same way as the others do I will lose out." I believe this attitude is wrong and that not only the good of the business but ultimately its very life depends upon the willingness and courage of some one or more in the positions of power to take a stand for that which is right and sound.

The contractors in turn are many times not only prone to listen to whispered suggestions but frequently go gumshoeing for the source of it and see if they can't utilize it when, as a matter of fact, most of the time they are doing themselves more harm than good. Should not the contractors place the handling of their business on a higher plane and not only endeavor to discourage the irresponsible element on the surety side but also demand that the surety executives do something to eliminate the necessity of the contractors having to deal with that undesirable element on the business-getting side of the surety.

HARMON V. SWART,
Contract Bonds and Insurance.

New York, N. Y.,
May 23, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Home Rule for Third Class Cities in Pennsylvania is authorized by a legislative bill signed by Governor Pinchot on April 8.

Commission-Manager plans of city government are to be voted on at Yonkers, N. Y., June 5 and at Schenectady, N. Y., June 15.

A **Department of Sanitary Engineering** in the Colorado State Board of Health is created by an act of the 1925 legislature. The bill carries an appropriation of $7,000 yearly.

The contract for 14 miles of 36-in. water mains for the city of Vancouver, B. C., has been let to the Vancouver Engineering Works, for $500,000. The pipe is to be of riveted steel construction.

Motor Buses may be owned and operated by the City of New York, according to a decision of a state supreme judge rendered May 11. The decision also upholds New York State Municipal Home Rule Law, upon which the city relied for authority to enact an ordinance providing for city-owned buses.

The League for the Control and Utilization of Waterways will hold a meeting at Grenoble, France, July 16 to 21, in connection with the "White Coal" exposition which is to be held there this summer. On July 22 a supplementary meeting will be held at Lyons, France.

A Course in Building Construction has been established at the Massachusetts Institute of Technology by Mr. and Mrs. Louis J. Horowitz. The purpose of this course is to train men in preparing estimates for building work and for the supervision of building construction. It will co-ordinate with the Department of Architecture, Civil Engineering and Economics. One scholarship is to be awarded each year to run for two years, the amount of each scholarship being $2,500.

The Water Policy Board of New Jersey, created to report to the next state legislature on the municipal water-supply problems of the state, including the entry by New Jersey into the proposed Delaware River compact with Pennsylvania and New York, has elected Willard I. Hamilton as chairman and Carroll P. H. Bassett as secretary. Mr. Hamilton is secretary of the Prudential Insurance Co. of Newark and Mr. Bassett is an engineer living at Summit, who was president of the Commonwealth Water Co. until recently.

Engineering Fifty Years Ago

From *Engineering News*, June, 1875

IT is most important that a young Engineer should cultivate an earnestness of purpose and determination of character, for this will enable him to carry to a proper end, and to do well, whatever he undertakes. How many important engineering matters have been brought to a point verging on a successful issue, and then, for want of a little 'energy' and determination, recklessly abandoned! First ascertain that what you aim at is within your reach, and then let nothing interfere with the attainment of your object. There are few ends which a good engineer cannot compass, if he has time and money at his disposal. He should, however, above all things, do well what he undertakes; it is better to fail altogether, than that the work should be done in a slovenly manner.—*Hints to Engineers.*

Awards for Electrical Men Established by James H. McGraw

To encourage individual initiative and creative thinking among electrical men, James H. McGraw, president, McGraw-Hill Co., Inc., has established four annual awards, three to be competed for by men of the manufacturing, jobbing and contractor-dealer branches of the electrical industry, respectively, and the fourth to be open, in addition, to the men of the central station industry. No separate award is made to men of the central station industry exclusively, in deference to the fact that this field is already covered by the James H. McGraw prize and other annual awards, presented each year at the convention of the National Electric Light Association. Each award will take the form of a bronze medal and a purse of $100 in gold. The Society for Electrical Development has been requested to act as sponsor for these awards and to appoint a committee and prepare an appropriate medal. The medals will be known as the Manufacturers Medal, the Jobber's Medal, the Contractor-Dealers Medal, and the Medal for Co-operation.

Begin Work on Estuary Tube at Oakland, Calif.

Ground was broken on May 19 for the $4,000,000 tube to be built under the estuary separating Oakland and Alameda, Calif. The contract, which is held by A. J. Crocker & Co. of San Francisco, is to be completed in 900 working days. An article descriptive of proposed methods for constructing this tube appeared in *Engineering News-Record*, Oct. 30, 1924, p. 720.

"Engineering News-Record" Wants Building Cost Data

Engineering News-Record is compiling cost figures covering the various elements of a building contract. It is desired to determine what proportion each element bears to the total contract price. Readers are urgently invited to contribute to this compilation, which it is believed will be of great value when completed. Unit cost figures are wanted on buildings of the following types:

Schools	Warehouses	Banks
Hotels & Apts.	Theatres	Exchanges
Offices	Churches	Factories
Hospitals	Clubs, Lodges & Halls	Power Plants
Stores	Public	Foundries

The following figures for a public school in New York City indicate the character of the data needed:

A NEW YORK PUBLIC SCHOOL

(Price of general contract, $330,000; 739,374 cu.ft., 44.63 cents per cu.ft.)

		Per Cent
Foundations	$16,929	5.13
Common brick	13,351	4.04
Front brick	9,512	2.88
Salt glaze	6,760	2.04
Enameled brick	3,987	1.20
Header and backer tile	5,426	1.97
Ornamental and ashlar T. C.	6,668	2.02
Flue lining	88	.027
Coping	375	.11
Anchors	825	.25
Wire mesh	1,898	.58
Dampproofing paint	905	.27
Waterproofing	276	.084
Cement wash	8	.0024
Ornamental iron	9,981	3.02
Roofing slag	75	.023
Roofing slate and tile	6,815	2.06
Millwork	19,590	5.94
Steel sash	233	.07
Kalmein work	3,666	1.11
Glazing	1,923	.84
Hardware	4,732	1.43
Painting	8,577	2.65
Sheet metal ducts	3,146	.95
Copper flashing	2,197	.67
Lathing	3,265	.99
Wall tiling	1,375	.42
Marble	18,456	5.60
Weather strips	1,542	.47
T. C. partitions	8,307	2.51
Plaster	4,637	1.40
Asphalt	794	.24
Finished floors	9,064	2.74
Steel shapes	41,969	12.70

Such unit cost lists as may be submitted will either be published or will be kept confidential, as the sender desires. The intention of *Engineering News-Record* is to lump together all figures covering the same operation or element (such as steel sash) of the buildings of one type. The final factor will be the percentage that each element of a typical school, bank, hotel, etc., is to the whole.

The final results will not be published in *Engineering News-Record*, but mimeographed copies for personal use will be presented to each individual or company supplying data of the type indicated. Please send your unit cost lists to:

Construction News Editor,
Engineering News-Record,
10th Ave. at 36th St.,
New York.

Contracts Awarded on Carquinez Strait Bridge

Foundations for a bridge of two 1,100-ft. cantilever spans and two 500-ft. anchor spans across Carquinez Strait, an arm of San Francisco Bay, are now being built for the American Toll Bridge Co. The bridge will be operated on a toll basis and will be chiefly for highway traffic, having only one railroad track designed for electric railway service. Although the work has been under way for some time, rearrangement of the financial plans has been only recently completed.

The original plan, under which construction was begun more than a year ago, contemplated the sale of stock as needed to finance the work. Recently the financial plan was changed to include the sale of bonds as well as stock with the idea of securing from contractors a lump-sum bid with a guarantee bond for price and completion. On April 23 the American Toll Bridge Co. signed an underwriting contract with the bond house of Bond & Goodwin & Tucker, Inc., of San Francisco, for the complete financing of the bridge. Contracts have also been signed for the entire substructure work with the Missouri Valley Bridge & Iron Co., of Leavenworth, Kan., and for the entire superstructure with the American Bridge Co., on a lump-sum basis.

From Nov. 1, 1923, to Feb. 1, 1925, the latter being the date when the financial plan was changed, the Duncanson-Harrelson Co., of San Francisco, carried on work on the foundations on a fixed-fee basis, the work done by this firm representing an expenditure of about $800,000. This included the completion of five of the minor piers, extensive work on the main piers, such as sinking the cofferdam and placing the tremic seal for Pier 4, and work on cribs for Pier 3. During the interval between Feb. 1 and April 23 the work was continued by the Missouri Valley Bridge & Iron Co.

Officers of the American Toll Bridge Co. are Aven J. Hanford, president; O. H. Klatt, vice-president, and C. Derleth, Jr., chief engineer. Wm. H. Burr is consulting engineer; D. B. Steinman is designing engineer; and George J. Calder, resident engineer.

Great Lakes Interests Plan Further Fight on Chicago

At a meeting held in the office of the Great Lakes Harbor Association in Cleveland on May 13 representatives of the various cities on the Great Lakes, mostly in the United States, announced that suit would be brought soon in the United States Supreme Court declaring that Congress has no right to legislate in favor of diversion of lake water and that the Secretary of War has no right to grant it by permit. The proposed action, advised by Attorney-General A. B. Daugherty, of Michigan, is directed toward the Chicago drainage canal, and if effective, would prevent the Sanitary District from diverting any water, except possibly for water supply purposes. from the Great Lakes into the Mississippi Valley.

Award of Washington Medal

The Washington Award, established by John W. Alvord, Chicago, for annual presentation by the Western Society of Engineers to some distinguished engineer, has been awarded this year to J. Waldo Smith, consulting engineer for the Board of Water Supply of New York, for "rare combination of vision, technical skill, administrative ability and courageous leadership in engineering." The presentation was made at the annual meeting of the society.

Board of Inquiry for "Norman" Disaster Appointed

Reports to the Corps of Engineers, as late as May 29, indicated that little progress had been made in the effort to find the cause of the sinking of the "Norman." The inquiry is being conducted by a board composed as follows: Major H. H. Stickney, district engineer, Mississippi River Dredging District; Capt. E. N. Chisholm, secretary, Mississippi River Commission; A. Miller Todd, assistant engineer, 3rd Mississippi River District; W. S. Mitchell, assistant engineer, Western District, and F. H. Hilliard, assistant engineer, Mississippi River Dredging District.

Letters have been sent to all known survivors asking them to transmit to the board a detailed statement of their experiences and impressions. A report will be made on the feasibility of raising the hull of the "Norman." A hydrographic and topographic survey of the entire vicinity is being made by Major Gillette for the board.

Reorganization of the St. Louis Board of Public Service

The new mayor of St. Louis has made a number of important changes in the personnel of the Board of Public Service of that city. All department heads, except that of the president of the board, have been replaced, but most of the leading bureau heads of the various departments remain unchanged. E. R. Kinsey, president of the Board of Public Service, was re-appointed and has made no change in his engineering corps, the leading members of which are W. E. Rolfe, his associate, and W. W. Horner, division engineer of streets and sewers. In the Department of Public Utilities, Director James A. Hooke has been succeeded by Edward E. Wall, for many years water commissioner of St. Louis. As the waterworks comes under the Department of Public Utilities, it will remain in the control of Mr. Wall. As water commissioner, however, there has been appointed to succeed Mr. Wall, John C. Pritchard, who has been assistant division engineer in charge of construction of the new Missouri River plant. F. T. Cutts, assistant water commissioner, C. M. Daily, division engineer, and Leonard A. Day, assistant engineer in the mechanical department, continue in office.

Major Clinton H. Fisk, director, Department of Streets and Sewers, has been succeeded by Robert B. Brookes. Joseph M. Slater continues as street commissioner. All the men thus far mentioned are civil engineers except Mr. Day, who is a mechanical engineer.

The Departments of Public Welfare and Public Safety are not necessarily headed by engineers, but until recently Nelson H. Cunliff was the head of this department. He has been succeeded by Harry L. Salisbury, who for many years has been closely connected with building construction in St. Louis.

In the Department of Public Safety, John Christophel has been succeeded by John H. Brod, Jr. Neither of these are engineers, but Mr. Brod has been connected with building construction for many years; at the time of his appointment Mr. Brod was an alderman. William C. E. Becker, a civil engineer, was building commissioner for the past year, although the law requires that the position be filled by an architect. He has been replaced by Edward Christopher, an architect heretofore employed in the Division of Bridges and Buildings, under the president of the board. Fire Chief William Panzer has been replaced by Charles Alt, a captain in the Fire Department.

Lifts Storage Embargo on the Rio Grande

Effective May 20 Secretary Work of the Interior Department lifted an embargo, established in 1896, preventing the granting of rights for the use of public lands along the Rio Grande in New Mexico and Colorado for water storage or diversion. Investigations into the legal phases of the original embargo have been under way for more than a year and have resulted in the opinion that the Secretary has no power to promulgate or maintain such an embargo.

The original purpose of the embargo was to prevent the building of dams, canals and other irrigation works on government lands along the river, pending settlement of water rights with Mexico and construction of the Rio Grande reclamation project. After the conclusion of a treaty with Mexico and the completion of this project, the embargo was permitted to continue, notwithstanding it was in conflict with a law of Congress passed in 1891. The treaty with Mexico has been concluded and Mexican rights defined and protected by the construction of the Elephant Butte dam, in which forty times Mexico's share of 60,000 acre-ft. annually is stored.

Further, the Secretary states in a memorandum accompanying the order that any rights granted to the use of public lands for storage and diversion are not grants of water but simply right-of-way grants. The granting of water rights or appropriation rights is entirely an affair of the state which creates, grants or establishes such rights. Appropriators must look to the states for adjudication of their priorities. The matter of the embargo or refusal to approve applications for rights-of-way for reservoirs and canals on the Rio Grande was recently brought to issue by the application for the Vega Sylvestre reservoir, a proposed irrigation project in Colorado.

Hold Mid-West Motor Transport Conference at Chicago

In a two-day session, May 27 and 28, at Chicago three transportation interests, rail, street railway and highway, attempted by discussion and resolution to allocate the proper position of the motor vehicle and how it should bear its proper burden of taxes. Details were gone into in sessions devoted to trucks and buses and highways. About 200 attended the conference, made up largely of executives of the motor truck, railroad, street railway and motor truck and bus interests. Only a sprinkling of engineers was in evidence. The subjects for discussion were largely economic and referred to traffic problems: Solving the City Terminal Problem; Who Pays for Our Highways; The Field of the Motor Bus; Economies of Motor Bus Operation; Commodity Transportation by Motor Truck; Why the Motor Truck is Successful as a Railroad Ally; Is Regulation of Interstate Motor Vehicles Necessary? In the same class was the address of the Secretary of Agriculture, William M. Jardine, on The Public and Highway Transport.

A paper on Cook County Survey by George F. Quinlan, superintendent of Cook County Highways, Chicago, covered briefly the results of the survey which has been made jointly by the county authorities and the U. S. Bureau of Public Roads. Out of the survey is coming a comprehensive highway plan for metropolitan Chicago by co-ordination of all the jurisdictions involved. Plans which have been agreed to will not be changed without submission to the group and conference. Dr. J. G. McKay, chief of Division of Highway Economics, U. S. Bureau of Public Roads, was the other engineer on the program. He gave some interesting comparisons of motor truck transportation of commodities, utilizing data obtained in the surveys made in Connecticut, California, Maine and Illinois.

Resolutions were passed advocating intrastate regulation of motor vehicle carriers by existing State commissions under uniform laws, the owners being required to obtain State certificates and to take out liability insurance. Legislation should be enacted to enable steam and electric railways and other public utilities to operate motor vehicles. Regulation of size, weight and speed of such vehicles should be uniform and administered by the State highway departments. There should be co-operation of all common carriers, and discussion of the traffic congestion problem should comprehend all agencies contributing to or affected by the problem. The traffic policy should develop the basic physical plan of the city, and large traffic centers should organize for study of this problem by joint committees representing the railways, the public and the motor truck interests. Plans should be formulated for the creation of metropolitan traffic districts surrounding the principal manufacturing centers, and comprehensive traffic surveys made similar to that in Cook County, Ill. The conference decided, also, to have a permanent organization under the name of the Mid-West Transportation Council.

Western Society Elects Officers

For the year 1925-26. One Western Society of Engineers has elected officers as follows: President, Homer E. Niesz, manager of industrial relations, Commonwealth Edison Co.; vice-president, F. E. Morrow, Major Rufus W. Putnam and John A. Garcia; treasurer, Geo. W. Hand. The secretary is Edgar S. Nethercut.

$2,200,000 Reservoir Bond Issue Carries in California

Construction of the Melones reservoir on the Stanislaus River in California, with a capacity of 100,000 acre-ft., to cost $2,200,000, was approved by voters in both the Oakdale and South San Joaquin irrigation districts on May 18 when a bond issue of that amount carried in both districts. Each district is to float half the total issue.

It is believed that interest on the investment and ultimate retirement of the 40-year bonds will be possible from the proceeds of power developed in a hydro-electric plant at the dam. The Pacific Gas & Electric Co. has entered into an agreement to construct and operate such a plant and to pay the districts approximately $125,000 a year for forty years for the use of water from the proposed reservoir.

Engineers Propose Memorials for Victims of Boat Disaster

Financial assistance to young men seeking engineering education as a memorial to Major C. H. Miller who lost his life in the Memphis boat disaster is proposed by the Little Rock (Ark.) Engineers Club. Just before the boat turned over Major Miller was one of the engineers at the meeting of members of the American Society of Civil Engineers who made a plea for the extension of help to the young man. Alfred M. Lund, who was on the boat helped save many lives by working with Tom Lee, the negro boatman, in dragging people out of the river, is chairman of the committee having the matter in charge. A. C. Butterworth and R. E. Warden, survivors of the disaster with Earle Hodges, D. W. Dickinson and N. B. Garber make up the committee. Mr. Warden states that Major Miller dragged him from the overturned boat in a semi-conscious condition and fastened a life preserver on him thus saving his life. Subscriptions are expected from many of the local and national organizations in which Major Miller was prominent.

In Memphis it is proposed to do something for Tom Lee and the *Commercial Appeal* has started a fund to buy him a home. The Memphis Engineers Club has also started a fund to be administered by a committee of engineers for Tom Lee's benefit. It is hoped that the two funds may be consolidated and administered by the engineers' committee. At the end of May the *Commercial Appeal* fund amounted to $2,300 and the Engineers Club fund to $600. Contributions will be appreciated and may be sent to either the *Commercial Appeal* or the Engineers Club.

Permit to Extend East Bay Water System Denied by Commission

The California Railroad Commission on May 26 denied the East Bay Water Co. of Oakland, Calif., permission to sell $9,500,000 worth of securities to finance its extension program, including a pipe line to Mallard Slough on the Sacramento River which was to supplement the company's present sources of supply. In making application the company stressed the necessity for immediate action to relieve the danger of water shortage. In denying the application the decision states that this project if carried out would "result in a duplication of facilities and a wasteful expenditure of money," this comment referring to the plans of the East Bay Municipal Utility District to which a $39,000,000 bond issue was recently voted for bringing in a water supply from the Mokelumne River, including provision for a temporary water supply from the San Joaquin River, *Engineering News-Record*, October 2, 1924, p. 559).

This decision places responsibility for meeting the increased water needs of the East Bay communities directly upon the East Bay Municipal Utility District. In commenting on this aspect of the matter, the decision says: "It seems clear that the responsibility for bringing in a temporary supply of water, pending the completion of the Mokelumne River project should rest upon the district, and that the evidence proves the willingness of the district to assume such responsibility, as well as the desire of the people residing in a district to hold the district responsible for such a supply."

George C. Pardee, president of the East Bay Municipal Utility District, testified that the district was doing everything it could to avoid any possibility of water famine. "The district is going to immediately proceed," he said, "to bring in its conduit and tunnels from the San Joaquin River, and if necessary, a pipe line over the hills through which water can be delivered before the tunnels are completed."

International Housing Conference to Be Held in Paris

The fourth International Housing Conference is to be held in Paris, France, June 15-19. The American delegation, appointed by the President, is as follows:

Noble Hoggson, president Hoggson Brothers, New York; John W. Harris, treasurer, Hegeman-Harris Company New York; Truman S. Morgan, president, F. W. Dodge Corporation, New York; I. N. Haughton, Toledo, Ohio; William Doyle, Philadelphia; J. C. Nichols, Kansas City, Mo.; General R. C. Marshall Jr., Washington, D. C.; Eugene C. Lewis, Detroit, and Walter Stabler, New York.

Mr. Willard Reed Messenger, of New York, has offered three prizes, one of $500, one of $300, and one of $200, to be awarded the winners of an international essay contest on any subject applicable to housing conditions together with practical methods of procedure.

WASHINGTON NOTES

Apparently power at Muscle Shoals will be available so sporadically during the testing period, which will extend from August to late next spring, that no formal contract will be entered into for such power as may be available for sale.

The electric contractors in charge of the installation which will convey the power away from the dam have advised the Chief of Engineers that the testing of machinery should be conducted under load and not with water rheostats as had been suggested.

It may require until December 1, or even the first of the year, General Taylor says, to complete the testing of the first four generators. It is expected that the switch board then will be ready for test after which the four other generators are expected to be ready for testing.

General Taylor believes it would interfere unduly with the completion of the project to be under any commitments or even under implied obligations to give advance notice as to the cutting off of power. He favors an arrangement whereby the tests can be made under the actual load that would be furnished through connection with the lines of the Alabama Power Company. That, however, will reduce the return to the government for the sale of the temporary power. With no assurance as to continuity of power it would be necessary for the Southeastern power companies to keep their steam auxiliaries ready for immediate use. Under such conditions these companies probably would be willing to pay for this power nothing more than the equivalent of such saving of coal as would result.

With the idea of discussing and taking action on the letter of the Secretary of War in regard to the disposition of power at Muscle Shoals prior to congressional action to that end, the President's Muscle Shoals Commission will meet in Washington, June 10. The Secretary of War wrote the Commission on April 14 in regard to the matter and requested an early reply. The delay has been occasioned, it is understood, by the belief of a majority of the Commission that no commercial use should be made of any of the power generated prior to its permanent disposition by Congress.

The grade of Associate Engineer has been created by the Chief of Engineers. The new grade carries a minimum salary of $5,200. This will make it possible to reward some of the assistant engineers who have exceptionally meritorious records. Eight assistant engineers have been promoted to the new grade as follows

L. D. Shuman, principal assistant engineer, Philadelphia; Henry W. Hobbs, Board of Engineers for Rivers and Harbors, Washington, D. C.; J. A. B. Tompkins, principal assistant engineer, Milwaukee; L. C. Sabin, assistant engineer, Sault Ste. Marie, Mich.; F. G. Ray, U. S. Lake Survey, Detroit; W. H. McAlpine, principal assistant engineer, Louisville; J. W. Arras, principal assistant engineer, Pittsburgh; E. D. Hardy, water supply engineer, Washington, D. C.

Major Paul S. Reinecke has been designated to take over the duties of assistant chief engineer of the Federal Power Commission to succeed Major Edgerton. Major Reinecke now is district engineer at Buffalo and field representative of the Federal Power Commission in that important hydro-electric district. He is a member of the joint board which measures the diversion made by the power companies on each side of the river.

Petition Presented in Chicago Diversion Case

Stating that several of the issues had been construed erroneously by the Court in arriving at its previous decision, a petition for rehearing of the case granting an injunction to the Government was filed in the United States Supreme Court, June 1, by attorneys representing the Sanitary District of Chicago in the Lake Michigan diversion case.

Among points raised in the brief supporting the petition for rehearing is one that the Court erroneously construed the Canadian boundaries-water treaty in which the sanitary district contends the report of the commissioners conceded that 10,000 sec.-ft. of water was allowed to be diverted at Chicago. It also is contended that the permits for opening the drainage canal and improvement of the Chicago River were irrevocable; that the limitation upon diversion of water from the lake was designed to prevent interference with navigation in the Chicago River and that the river had been improved and straightened at a cost of some $14,000,000, thus removing the original cause of the limitation. The Court, in sustaining the injunction, erroneously construed the permits, it is argued. It also is contended that the Government had sought relief exclusively under the river and harbor act of March 3, 1899, but that the Court had not confined its decision to construction of that law but had applied other principles, thus having gone outside the case.

Power Developed by New York State Sold at Good Figure

The superintendent of public works of the State of New York has entered into a 25-year contract for the sale of surplus power from the hydro-electric plants built by the state on the Barge Canal. The Cohoes Power & Light Co. contracted for the power at Crescent dam at an annual rental of $174,220, and the Adirondack Power & Light Co. will pay $191,020 per annum for the excess power from the plant at Vischer Ferry. The superintendent of public works estimates that of the $365,240 annual income $65,000 will be required for maintenance and operation of each plant and $80,000 will be required for sinking fund and interest charges. This will give the state a net income of about $155,000.

Random Lines

Why Work?

We have always thought those real estate men down in Florida were hypnotists, especially since we learned that everybody who went to Florida last winter made a million or so selling property to somebody else who made another million selling it to somebody else. But the prize story comes to us in a house organ of a construction company down South. This company has an employees' co-operative association. This co-operative association has a savings club. The big boss was down in Florida last winter. He got the real estate fever, or in the words of the polite house organ, "has been investing in Florida dirt and is thoroughly qualified as a judge of values." At any rate, he wired from Tampa offering to help finance a deal whereby the co-operative association might secure an equity on a lot located in the business section of Tampa, Fla. The first cash payment required was $1,000. The association had only $989 in the treasury, but the office soon made up the $11, and the wire of acceptance "was quickly on the way to Tampa." Now listen to the optimism of the editor of the house organ: "There is little doubt but that our $1,000 will have doubled in twelve months. Those who know say that such an estimate is entirely conservative. So it is that we are doing as an organization what no individual amongst us could do, and our monthly savings are now bringing in a far greater earning than in any other way." Whaddaya mean, "no individual could do?"

* * *

Amending Nature

In view of certain recent legislative divagations into the realms of science a columnist in the New York *Times* suggests the following news notes from a paper in 1930:

In Kentucky the statutory formula for water after Jan. 1, 1927, for all qualified voters, persons residing more than one year in the State and non-taxpaying Indians was fixed at H_2O.

In Mississippi, the square on the hypothenuse was amended so as to be equal to twice the sum of the squares on the other two sides, except on articles in interstate commerce.

In Texas, the Legislature of 1928 succeeded after a bitter struggle in overriding the Governor's veto and enacting that a body falling under the pull of gravitation shall travel a uniform distance of sixteen feet during every second of its journey.

* * *

Them Were the Days!

Sir—We have found an excuse for "the sinuous and undulating layout of some of our ancient roads," in the Nottingham, New Hampshire, Town order of 1809. "Voted to buy ten gallons of West India rum for the surveyors to be drunk while at work on the roads."

May 4, 1925. P. A. S.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Union College, Schenectady, N. Y., June 17-20, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Summer Meeting, Salt Lake City, July 8-10, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-29, 1925.

The Brooklyn Engineers Club held its 29th annual meeting and dinner on May 20 and elected Calvin C. Hough president.

The Engineering Institute of Canada will hold a Western Professional Meeting at Banff, July 13-16. This will be the second convention of this nature to be held by the Institute at Banff and will be similar to the one held in August, 1920, when the party went under canvass and the Calgary Branch carried out all arrangements and responsibilities of the undertaking.

Camp accommodation for about 200 persons is being arranged, and such accommodation will be extended to the wives and families of members. The camp will include dining facilities, and will be fully equipped with cots, bedding and general conveniences. The camp will be pitched Saturday July 11 for the benefit of those who come for the week-end.

Personal Notes

GEN. R. C. MARSHALL, JR., of the Construction Division of the Army during the World War and now general manager of the Associated General Contractors, has been appointed a delegate to the fourth international congress of the building industry and public works to be held in Paris June 15-21, 1925, and he has been tendered the chairmanship of the American delegation.

J. O. B. COULLING, assistant to the chief engineer of the M. A. Long Co., Baltimore, Md., whose article in this issue of *Engineering News-Record* describes the use of moving forms in grain elevator construction, has now joined the organization of the Spencer Construction Co., Baltimore, Md., for work in a similar capacity in the design and construction of cement plants, utilizing the moving form in connection with large storage bins and pack houses.

COL. EDWARD M. MARKHAM, formerly district engineer, Corps of Engineers, U. S. Army, Detroit district has been transferred to Fort Humphreys, near Washington, to command the engineer school. LIEUT. COL. ELLIOTT J. DENT has been appointed district engineer at Detroit to succeed Col. Markham.

PERRY A. FELLOWS has been appointed city engineer of Detroit, Mich., succeeding GEORGE JEROME, whose resignation became effective June 1. Mr. Fellows graduated in civil engineering from the University of Michigan in 1906 and later served there as instructor in engineering from 1916 to 1917. After graduation be served with the Central of Georgia Ry. as assistant engineer and superintendent of dredging in the right-of-way department and on the building of new terminals at Savannah and Macon, Ga., as assistant engineer with the Atlantic Coast Line, and later as general superintendent for the Winnsboro Granite Corp. in charge of railroad, quarries and manufacturing plant. For the past eight years he had been associated with Frederick Stearns & Co., Detroit. During the time Mr. Fellows was an instructor at the university he was employed on valuation of the Michigan Central R.R. and was on the board that was in charge of the Belle Isle bridge at Detroit. He is at present a member of the newly appointed committee on sewage disposal for the city of Detroit.

GEORGE F. JENKINS, president of the George B. Swift Co., Chicago, Ill., and connected with that company since its organization in 1898, has severed his connection and hereafter will be connected with the Walsh Construction Co. and the H. A. Peters Co., general contractors, Chicago, Ill.

STARLING M. MORSE, civil engineer, has been appointed city manager of Mesa, Ariz. The past two years Mr. Morse was county engineer for the Apache County Highway Commission, with headquarters at St. Johns, Ariz.

F. T. CROWE, federal construction engineer, recently located at Rimrock, Wash., has resigned, to take charge of an irrigation construction project near Guernsey, Wyoming.

D. B. JOHNSTON, division engineer of the Pennsylvania R.R. (Southwestern Region) at Louisville, Ky., has been appointed assistant to the chief engineer of maintenance-of-way, St. Louis, Mo.

F. N. CROWELL, assistant division engineer of the Pennsylvania R.R. at Louisville, Ky., has been transferred to Indianapolis, Ind.

J. T. JOHNSTON, assistant chief engineer and assistant director, Water Power Branch, Department of the Interior, Ottawa, Canada, has been appointed director and chief engineer of the Dominion Water Power and Reclamation Service, which since 1923, has combined the water power and reclamation services; in this position he succeeds J. B. Challies who recently accepted an executive position with the Shawinigan Water & Power Co. Mr. Johnston is a graduate of the University of Toronto and a member of the Lake of the Woods Control Board, Interdepartmental Committee on the St. Lawrence waterway, and consultant to the government on international waterway problems.

Obituary

VERNON BAKER, Webster Groves, Mo., vice-president and chief engineer for the Russell Engineering Co., St. Louis, Mo., died May 16 at Boston, Mass., of pneumonia. Mr. Baker was one of the organizers of the Russell Engineering Co. in 1914.

IRA H. CARPENTER, civil engineer, New Rochelle, N. Y., and a graduate of Rensselear Polytechnic Institute died May 26 at his home in New Rochelle, aged 35 years.

ALEXANDER C. ARMSTRONG, civil engineer who had been associated with the American Bridge Co. since 1913, died May 21 in a hospital in Long Island, New York; he was 50 years of age. Mr. Armstrong was a native of Hamilton, Ont., and was educated in Hamilton and Toronto. After some experience in Canada and the United States he went to South Africa in 1907 as local manager for Milliken Brothers, steel constructors, but returned to New York in 1913.

FREDERICK E. SHAW, contracting engineer, Providence, R. I., died May 25 of a heart attack, aged 65 years. The name of Mr. Shaw is connected with many construction projects in New England; among others were the planning and directing of the filtration plant of the Providence water-works at Pettaconsett, the foundations of the Providence union station, the rebuilding of the Harbor Junction and the Wilkesbarre pier docks, and work in Northampton and Malden, Mass., and New London and New Haven, Conn.; his largest undertaking was the state pier at Providence. He was at one time inspector of sewers in Providence. He was a graduate of Brown University.

THOMAS N. JACOB, consulting engineer on drainage work, St. Louis, Mo., died of pneumonia on May 25. Mr. Jacob was born in Washington, D. C. in 1866 and entered the service of the Chicago, Milwaukee & St. Paul R.R. in 1886 as an axeman on survey work. From 1886 until 1895 he was on railroad construction work in the West and again from 1898 until 1903 was on railroad construction. In the interim he was assistant engineer, U. S. Engineer Corps, investigating Mississippi River improvement and levee construction. In 1903 he began private practice and continued until in 1909 he became chief engineer of the East Side Levee and Sanitary District, St. Louis, which position he held until the work of the district was completed in 1913, when he returned to private practice, specializing in drainage work and making his headquarters at St. Louis.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Treasury Department Investigates Imports of Reinforcing Bars

An investigation has been started by the Treasury Department to determine if German exporters are dumping iron and steel products in the United States. The investigation was instigated by manufacturers and dealers in bars used for reinforcing concrete, who claim that German bars are being laid down at Gulf Ports for $34 a ton. The duty on ordinary merchant bars is $10 a ton; comparable domestic bars are selling at $45. As the laid down price of German bars decreases, they are being sold farther inland, the reduction overcoming the railroad freight.

In addition to asking for an investigation by the Treasury Dept., steel representatives have appealed to the Tariff Commission for an increased tariff on these products. These representatives were advised that one item may be taken out of a basket clause and the duty increased under the flexible tariff. The Commission will take no action, however, until the Treasury Department reports the results of its inquiry.

International Trade Exhibition

The International Trade Exhibition, a proposed permanent exhibition of materials and equipment from the several states and foreign countries, is to open in New Orleans, Sept. 15. Governmental sanction has been obtained in the form of an invitation by President Coolidge, addressed to all prospective exhibitors, and also in the donation by the federal government of a six-story building containing 500,000 sq.ft. of floor space.

The exhibition has been organized and is managed by leading business men of New Orleans. Its promoters believe that both buyers and sellers will find economies in this method of getting together. The charter provides that no profits shall be distributed, and that all earnings shall be appropriated to advertising the exhibition. C. L. Wallace, former head of the Texas-Pacific R.R., is president of the operating company.

Business Notes

LINK BELT CO., Chicago, announces a new plan whereby complete lines of silent chain drives of from ¼ to 10 hp. are now available from distributors. This practice is an innovation since silent chain drives have, heretofore, been sold only on a made-to-order basis.

ALEXANDER MILBURN CO., Baltimore, Md., announces a monthly photo contest offering a prize of $25 per month for the best photograph or sketch illustrating work done with Milburn welding and cutting apparatus.

INDUSTRIAL WORKS, Bay City, Mich., has opened two new sales offices, one in New Orleans, John A. Abele, manager, and the other in Atlanta, John J. Murphy, manager.

R. W. HEBARD & CO., New York, announces that their construction operations in Central America are being carried on by a force of 8,000 men. This, they believe, is the largest force mobilized by an American contractor in foreign countries in recent years.

NORTHERN CONVEYOR & MFG. CO., Milwaukee, builders of portable conveyors, will move to Janesville, Wis., about June 1. The new plant will provide facilities for tripling their present production of two conveyors per day.

SULLIVAN MACHINERY CO., Chicago, announces the appointment of Earl E. Miller as manager of its El Paso office succeeding R. S. Weiner, who is transferred to the general offices at Chicago.

INTERNATIONAL GENERAL ELECTRIC CO. has received an order for two horizontal water-wheel generators, said to be the largest horizontal unit ever made, to be delivered to the Sao Paulo Tramway Light and Power Co. of Brazil. The generators are rated 33,000 kva., 85 per cent power factor, 360 r.p.m., 11,000 volts, 60 cycle, 3 phase. They will be driven by Pelton double overhung waterwheels, operating under a head of about 2,300 feet.

BOLIVIAN INDUSTRIAL EXHIBITION will be held in August to commemorate Bolivia's centennial. American participation has been formally requested. Manufacturers are offered free sites and reduced freight rates for their exhibits, which will be admitted duty-free.

CHAS. CORY & SON, INC., New York, manufacturers of valve controls, flow meters, ohmmeters, interlocks and similar apparatus, has opened an office in Chicago. The new office is in charge of Harry D'Almaine.

BRODERICK & BASCOM ROPE CO., St. Louis, have recently finished what is said to be the longest and heaviest cable ever made for incline purposes. It is 9,200 ft. long, 1¾ in. in diameter and weighs 50,000 lb. The reel, upon which it was shipped, was 8½ ft. high and weighed 3,180 lb. The company has recently moved into its new plant which will greatly facilitate its output.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO. announces changes in its personnel. J. S. Tritle has been made general manager of the merchandising department and will transfer his headquarters from New York to Mansfield, Ohio. C. E. Stephens, formerly manager of Central Station Division N. Y. office has been appointed manager of the N. Y. sales office in place of A. E. Allen who resigned to accept a position with the Westinghouse Lamp Company.

PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., announces that T. J. Barry has been appointed district representative with offices in the Park Building, Pittsburgh.

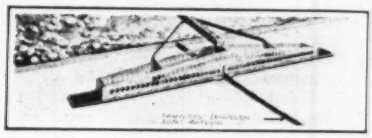
BROWN HOISTING MACHINERY CO., Cleveland, Ohio, announces the following appointments in its sales organization: J. P. Case, sales manager, J. F. Poland, manager, Chicago office, and E. W. Taylor, manager, Pittsburgh office.

AMERICAN ASPHALT ROOF CORP., Kansas City, Mo., has recently purchased the plant of the Stormcote Roofing Co., East St. Louis, Ill., which comprises 11 acres of ground and 11 buildings.

Equipment and Materials

Metal Float and Straight Edge for Concrete Road Finishing

The Walstad Machine Co., Tacoma, Wash., is marketing a 6-ft. metal straddle float and a 6-ft. metal straddle straight-edge for concrete road construction. These tools, being made of metal, are not subject to the warpage that affects wooden devices; hence their



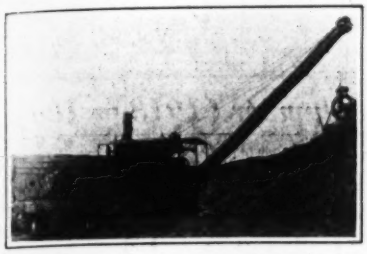
alignment is permanent. The wooden finishing boards on the float alone require renewal. The metal is an aluminum alloy and the equipment weighs 5¼ lb. It is claimed by the manufacturer that the combination of the metal straight-edge and the metal float makes possible a good job at the expansion joint and eliminates the wavelike effect resulting when wooden tools are used.

Improved Traction System for Crawler Crane

The new 10-ton crawling tractor crane of Industrial Works, Bay City, Mich., embodies several new features among which are split gears for propelling purposes, 25 per cent increase in speed, double clutch mechanism, and long tractor belts, the distance between the two end sprockets being 10 ft. The split gear system permits each tractor belt to be separately controlled by two friction clutches. Two concentric vertical propelling shafts at the axis of revolution lead two independent but concentric trains of spur and bevel gears, each operating one tractor belt. This feature facilitates maneuvering in close quarters. This machine is an all-gear drive from engine to the sprockets, no chains being required.

The crane can be equipped to operate with a steam, gasoline or Diesel engine,

or electric motor. All speeds of the crane have been increased 25 per cent. By means of the double clutch mechanism, the direction of slewing the tractor



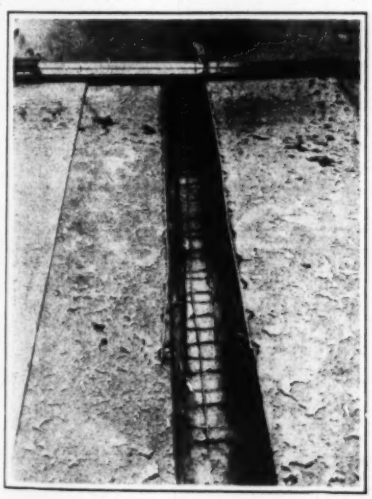
belts is changed by a lever; no reversal of the engine is necessary. Any equipment that operates on a boom may be applied to this machine.

Stirrups of Wire Mesh for Concrete Beams

In an attempt to overcome the many difficulties commonly experienced in placing steel reinforcement in concrete beams, Joseph T. Ryerson & Son, Inc., Chicago, have developed a reinforcing unit of continuous stirrups made from wire mesh. By means of special machinery sheets of mesh up to 10 ft. in width can be formed into stirrups whose upper ends are hooked so as to fit over the edges of the wood forms.

Field labor is reduced to a minimum by merely dropping the stirrups into position in the forms. The stirrup units then constitute a support for the main reinforcing steel which is wired to it at convenient intervals. Only in cases of extremely long beams will the usual bar supports be needed at the center of the beam. Although wire mesh is usually made with the main wires uniformly spaced, it can be furnished with a close spacing at the end, increasing toward the center, thus conforming with shear requirements.

The new Palmer House, now being constructed in Chicago, will contain



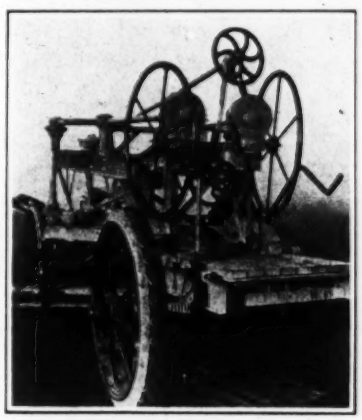
about 33,000 of these wire mesh continuous stirrups. Most of these are being used as shear reinforcement for concrete beams, although in some cases they are used as wrapping for steel beams for which purpose they are readily adapted.

Although some saving results from the elimination of the usual bar supports, the major economy is claimed to result from reducing the field labor to a minimum.

Rubber-Tired Grader

To meet the demand among highway officials for a road grader which can be used with a motor truck in road work and then hauled a distance to the next job without loss of time and mechanical wear, the Stockland Road Machinery Co., Minneapolis, Minn., has produced a new rubber-tired grader with 8-ft. blade, known as the Greyhound.

The entire front end of the grader is made heavier than standard construction to accommodate scarifier attachments and to hold them to the ground. Another feature is the inclosing of all gears in dust-proof steel cases which permit the running of gears in oil or grease. The Alemite system of forced lubrication is used throughout the machine. Hyatt heavy duty bearings are



used on the wheels, while all other bearings are either of bronze or babbitt, and are protected with felt washers to help hold the grease and keep out the dust. The wheels are equipped with 40x5 solid rubber tires on the rear of the machine and 32x4 solid tires on the front. The grader weighs 5,000 lb.

Publications from the Construction Industry

Floors, Concrete and Paints — L. SONNEBORN SONS, INC., New York City, has just published an indexed folder, filing size, containing four individual folders that contain complete description, data and sample specifications on floor treatments, damp proofing and waterproofing, acceleration, densifying and protection against freezing of concrete and cement mortars, dry mineral colors for mortars, interior and exterior painting and decorating, structural steel painting, technical paint specialties, and protection of roofs.

Pipe Flanges — AMERICAN SPIRAL PIPE WORKS, Chicago, is distributing a new catalog of forged steel pipe flanges, which is also a handbook of valuable information for engineers, designers and operators of power systems. Formulas and data tables are placed so as to permit of quick and easy reference. Besides complete data covering existing standards, there are embodied the new American Engineering Standards which make all thicknesses uniform with the old cast standards. The catalog is illustrated with full-size cross-sections, which, with tables and some half-tone illustrations, intelligently convey the best modern practice in the field of increasing pressures and superheat. There is also a section on corrugated steel furnaces.

Finish for Wall Surfaces—UNITED STATES GYPSUM CO., Chicago, has issued two 24-p. limited edition books. One describes the uses and advantages of "Textone," a new material which the makers claim is not a paint but a plastic medium producing any texture or color to harmonize with any requirement. It is asserted that with this material "there open to us unlimited possibilities of obtaining the fresco surfaces of the masters of the Renaissance, the texture quality of the early Gothic and Spanish, or the richness of Arabian walls with all the color variation of the Orient." The book is beautifully illustrated with examples of architecture of the Greek, Spanish, Early Italian, Early English, Gothic Modern European, Colonial and Moorish types. The other treats of "Oriental Stucco," by the use of which it is claimed that "the rough textures of the Greeks, the modulated surfaces of the Italian and Spanish, the sand finish of the English and the trowel surfaces of the later periods are again possible." Fine illustrations are included of exteriors of houses, stuccoed in the Greek, Italian, English, French, California Mission, Modern American, Modern European and Modern Californian styles.

Loading Equipment — GEO. HAISS MFG. CO., New York City, publishes a booklet for the road builder, which shows the advantages of truck loaders as labor savers. It contains two usable diagrams, one showing the comparative cost per day of loading trucks with hand shoveling and with machine loading, the other for calculating the number of trucks required to move any definite yardage for various miles of haul.

Sewer Pipe Joints — PRESSTITE CO., St. Louis, Mo., tells in a 10-page booklet the advantages of the Ferguson Presstite watertight sewer-pipe joint. This is an asphaltic jointing which comes in a flat strip that is placed in the bell end of the pipe. The spigot end of the other pipe is pressed in by a pressure jointing device and it is claimed that the asphaltic compound is squeezed out so as effectively to seal even the smallest openings in the joint.

Weldless Steel Poles—VIELÉ, BLACKWELL & BUCK, New York City, cite fifteen advantages of Mannesmann one-piece seamless tubular steel poles in Bulletin 12, just issued. It is claimed that they are especially suited for trolley, telephone, telegraph, transmission lines and electric lighting systems.

Engineering News-Record Statistics of the Construction Industry

June 4, 1925 — *in the United States* — Vol. 94, No. 23

Engineering News-Record CONSTRUCTION COST Index Number (1913 = 100)

MONTHLY

Jan. 1924 to Date

June, 1925	**204.60**
May, 1925	207.20
June, 1924	216.85
Peak, June, 1920	273.80
1913	100.00

1924

Jan.	217.90	May	222.33	Sept.	211.25
Feb.	220.30	June	216.85	Oct.	207.55
March	224.60	July	214.40	Nov.	205.70
April	221.60	August	213.15	Dec.	208.58

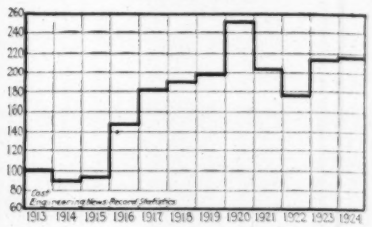
1925

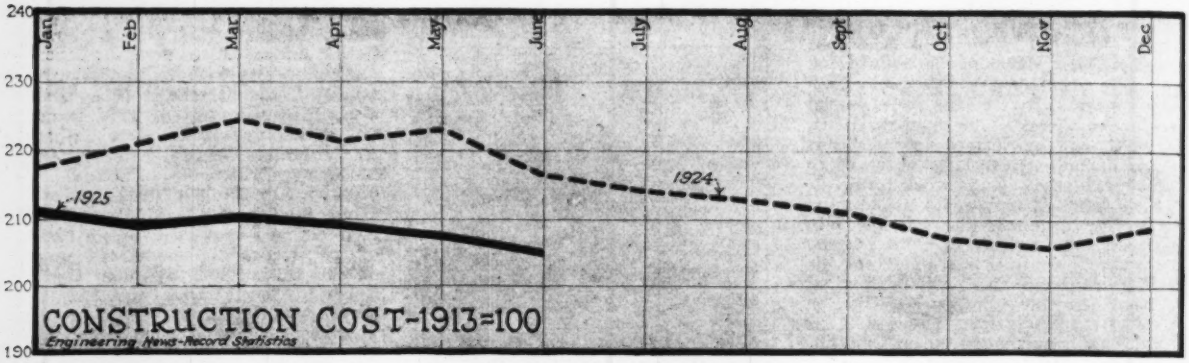
Jan.	210.40	March	210.20
Feb.	209.70	April	209.55

ENGINEERING NEWS-RECORD'S Construction Cost Index Number declined 2.6 points since last month owing to slightly lower cost of lumber and common labor. The average rate for common laborers is now 53c. per hr. for the entire country, against 54c. one month ago and 56c. in June, 1924. Thus general construction cost is 6 per cent lower than one year ago and 25 per cent under the peak; it is 105 per cent above the 1913 level.

YEARLY

1913 to 1924





Engineering News-Record CONSTRUCTION VOLUME Index Number (1913 = 100)

MONTHLY

Jan. 1924 to May, 1925

May, 1925	**209**
April, 1925	211
May, 1924	194
Peak, May, 1922	221
1913	100

1924

January	125	May	194	September	159
February	144	June	149	October	164
March	161	July	161	November	128
April	159	August	162	December	145

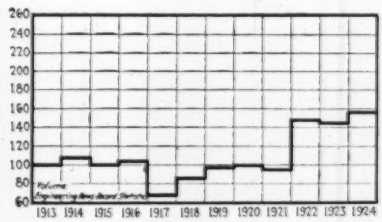
1925

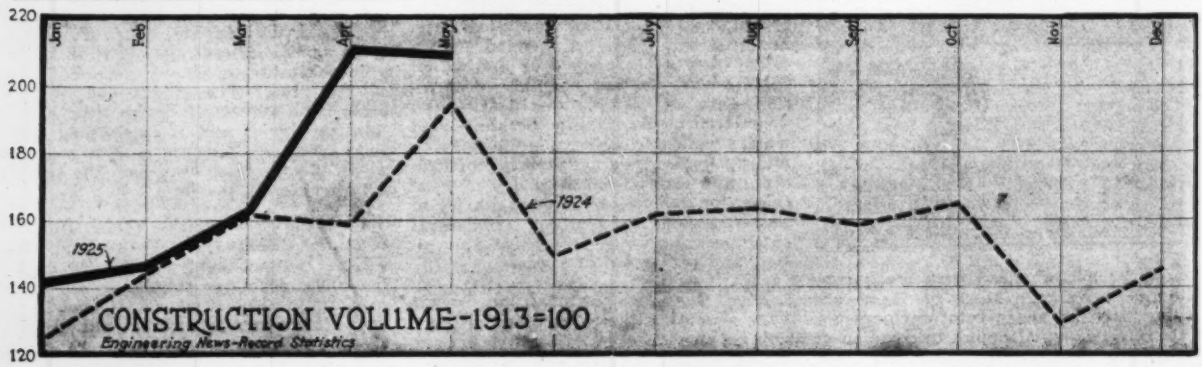
January	141	February	145	March	161

ENGINEERING NEWS-RECORD'S Construction Volume Index Number is 209 for the month of May, and 154 for the whole of 1924, as against 100 for 1913. This means that the actual volume of construction in 1924 (not the mere money-value of the contracts let that year) is 54 per cent above the volume of construction for 1913. The monthly volume number, 209 for May, 1925, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

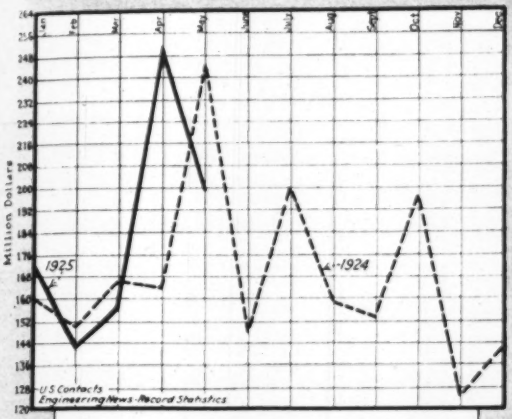
YEARLY

1913 to 1924

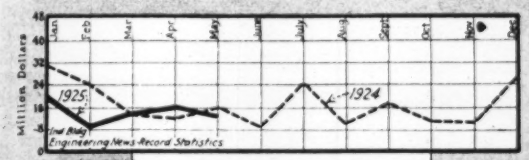




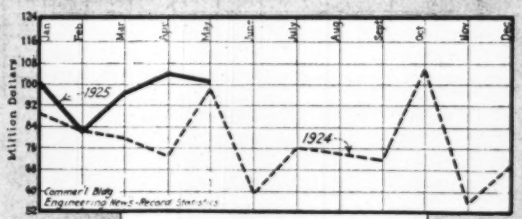
Engineering News-Record Monthly Construction Statistics



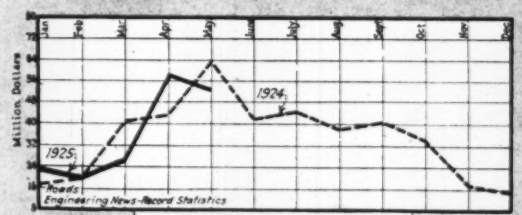
Contracts Awarded in the United States
Reported in E. N.-R.



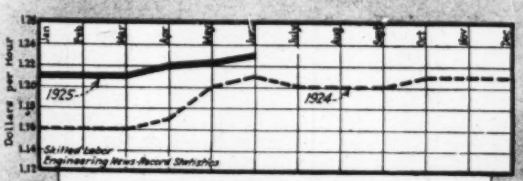
Industrial Building Awards
$40,000 and Over



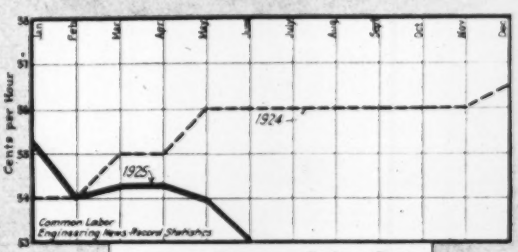
Commercial Building Awards
$150,000 and Over



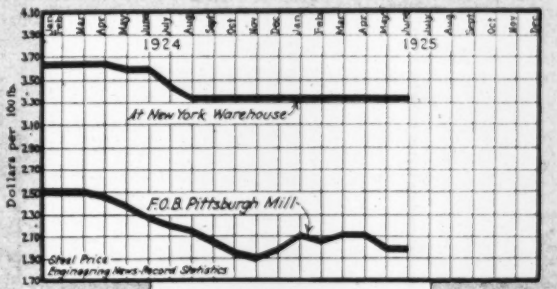
Street and Road Lettings
$25,000 and Over



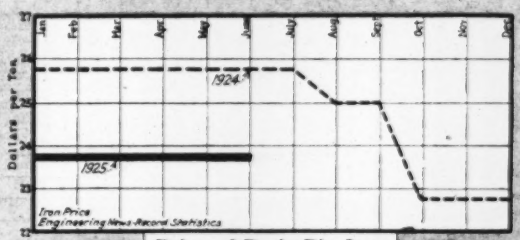
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



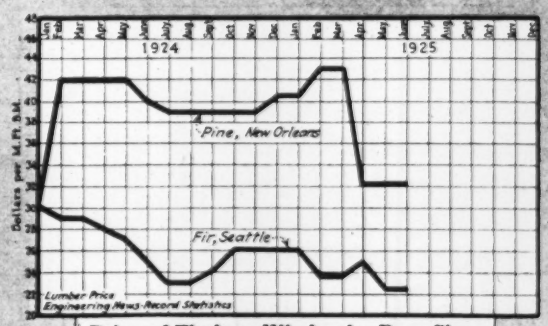
Average Common Labor Rate
Pick and Shovel Men



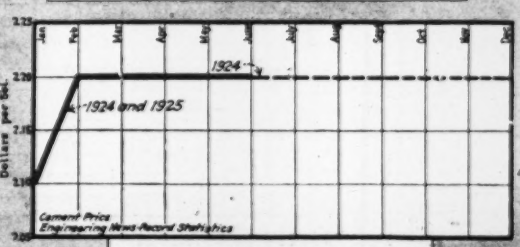
Price of Steel Structurals
Shapes 3-In.; Plates ¼-In.



Price of Basic Pig Iron
F.o.b. Pittsburgh

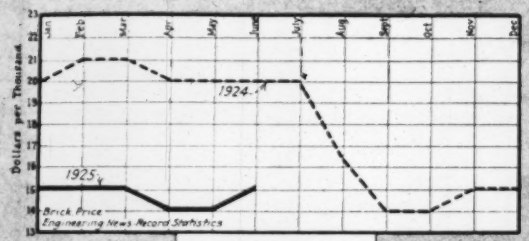


Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors

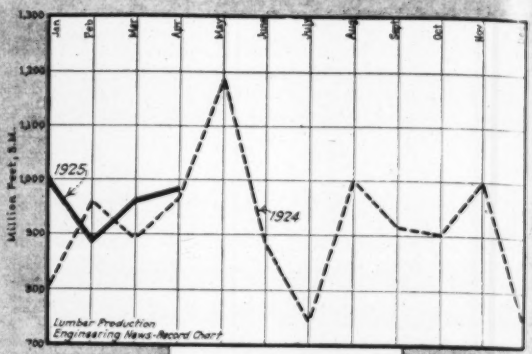


Net Price of Portland Cement
Car Lots, F.o.b. Chicago

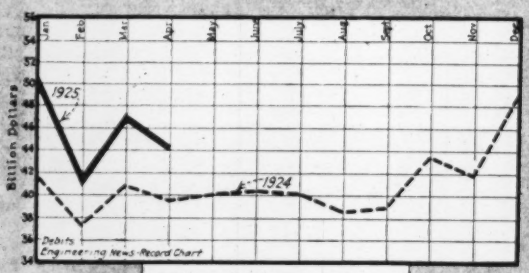
Engineering News-Record Monthly Construction Statistics



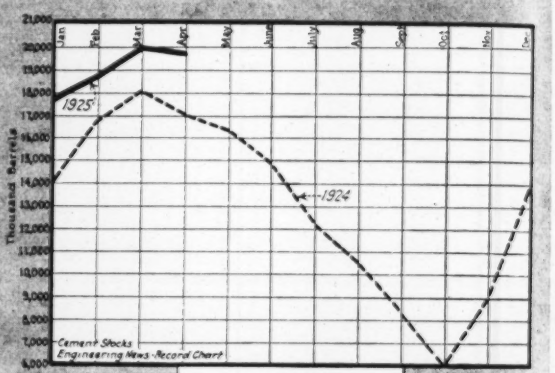
Price of Brick
At Dock, New York



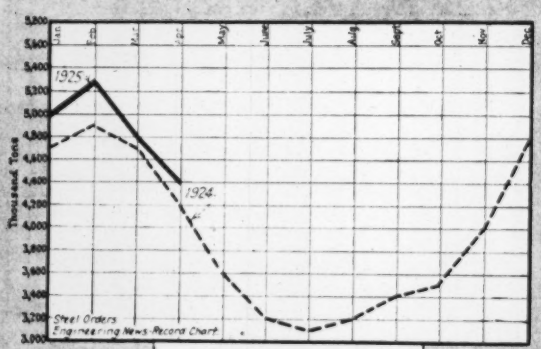
Lumber Output
Nat. Lumber Mfrs. Assn.



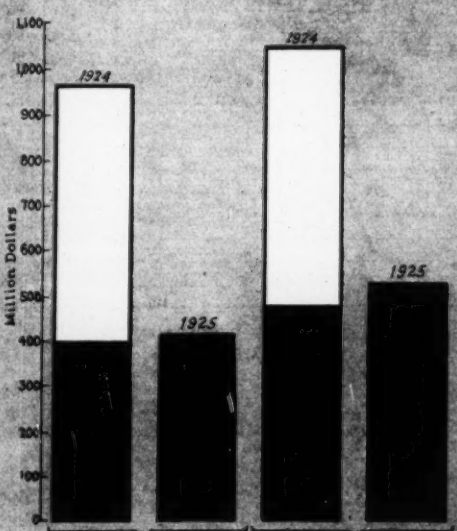
General Business Trend
Bank Debits—Federal Reserve



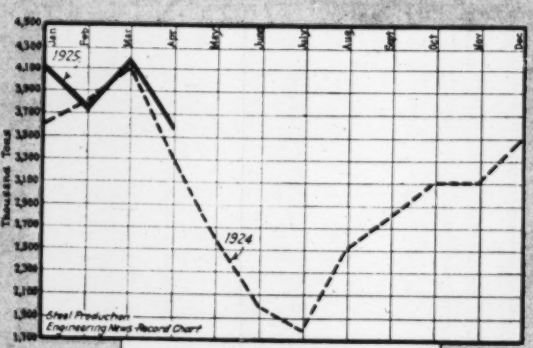
Cement Mill Stocks
Geological Survey



Unfilled Tonnage
On Books of U. S. Steel Corp.



Public—Contracts—Private
Jan. 1 to date ▬
Reported by E. N.-R.



Steel Ingot Output
Gross Tons; Am. Iron and Steel Inst.

Contract Value, January 1 to June 1, Seven per Cent Ahead of Same Period Last Year

MAY construction was 7 per cent greater in actual physical volume than that for the corresponding month in 1924.

Measured by money value of contracts let, the awards for the entire country from Jan. 1 to June 1, 1925, were also 7 per cent ahead of the same period last year.

Compared with a year ago to date, construction is on the up-grade everywhere throughout the country except in the South and the Middle West. In the South, the slowing down is mainly in public works, while in the Middle West it is confined to bridges, industrial and commercial buildings.

For the country as a whole the greatest activity, compared with a month ago, is in sewers and excavation jobs.

Minimum costs observed in the table below are: water-works, and excavations, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial buildings, $150,000.

Principal among the large projects awarded during the month were the following twelve: (1) office building, New York, N. Y., $18,000,000; (2) office building, Brooklyn, N. Y., $5,500,000; (3) office building, New York, N. Y., $5,000,000; (4) glass factory, Creighton, Pa., $4,000,000; (5) office building, Springfield, Mass., $3,000,000; (6) capitol, Lincoln, Neb., $2,515,000; (7) dam, Newburg, Ind., $2,359,000; (8) office and theater, St. Louis, Mo., $2,300,000; (9) railway, M. P. R.R., $2,000,000; (10) auditorium, Minneapolis, Minn., $1,757,000; (11) stock exchange, Omaha, Neb., $1,500,000, (12) stadium, Philadelphia, Pa., $1,377,000.

Value of Contracts Let in the United States and Canada, May, 1925

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Far West	United States	U. S. Jan. 1 to June 1	Canada
Water-works	$30,000	$686,000	$926,000	$1,391,000	$617,000	$416,000	$4,066,000	$29,341,000	$803,000
Sewers	313,000	4,898,000	167,000	1,813,000	925,000	663,000	8,779,000	29,235,000	219,000
Bridges	.....	187,000	246,000	468,000	1,249,000	443,000	2,593,000	24,080,000	937,000
Excavations, dredging, etc.	61,000	134,000	52,000	101,000	189,000	835,000	1,372,000	4,832,000	.....
Steets and roads	2,591,000	15,567,000	5,940,000	11,429,000	9,969,000	7,922,000	53,418,000	181,666,000	3,219,000
Industrial building	1,195,000	7,135,000	425,000	2,360,000	897,000	720,000	12,732,000	70,955,000	150,000
Commercial building	12,045,000	44,810,000	5,083,000	11,678,000	19,687,000	8,270,000	101,543,000	505,389,000	1,799,000
Federal government	242,000	15,000	780,000	2,882,000	102,000	444,000	4,465,000	17,402,000	.....
Unclassified	471,000	2,985,000	.....	890,000	5,595,000	296,000	10,237,000	78,319,000	4,600,000
May, 1925	$16,918,000	$76,417,000	$13,619,000	$33,012,000	$39,230,000	$20,009,000	$199,205,000	.....	$11,727,000
May, 1924	9,358,000	67,556,000	27,650,000	54,498,000	48,761,000	31,962,000	239,785,000	.....	13,931,000
April, 1925	18,780,000	85,627,000	14,851,000	64,729,000	38,335,000	31,181,000	253,503,000	.....	10,934,000
1925, Jan. 1 to June 1	79,505,000	329,499,000	73,319,000	169,012,000	170,279,000	119,405,000	941,019,000	.....	31,739,000
1924, Jan. 1 to June 1	51,183,000	276,577,000	104,844,000	178,243,000	144,645,000	124,537,000	880,029,000	.....	49,208,000

Labor Rates and Conditions Throughout the Country

WITH construction well ahead of last year to date, a brief survey of conditions in other industries reveals many favorable developments as against few in the opposite direction.

Chief among the signs of improvement are: steady increase in sales of fabricated structural steel since Jan. 1; improvement in buying of raw cotton; unprecedented automotive output; increased employment in manufacturing of agricultural implements, rubber, silk, chemicals, paper and pulp; steadily increasing chain store sales; new high records in mail-order sales; copper consumption close to peak; gasoline consumption ahead of year ago; freight loadings ahead of corresponding period in any preceding year.

Loadings of merchandise in less-than-carload lots, represent about the same percentage of total weekly loadings as at this time last year. This may be taken to indicate that the tendency to buy in small-quantity orders, frequently repeated, is no greater than it was in 1924.

Of 10,000 answers to inquiries recently sent out by the National Manufacturers' Association, only 19 per cent reported depression.

Iron and steel production is slower than it was during the first quarter. Nearly all the metals are affected by the hand-to-mouth buying policy now in force in these markets.

Reduction in employment is also reported in the furniture, meat packing, woolen and cotton textile industries.

Strikes and controversies coming before the U. S. Department of Labor are apparently increasing from week to week according to the National Industrial Conference Board. New cases reported, involve building trades mechanics; dredgemen; traction workers; elevator operators; stove, textile and clothing workers; photographers; cigar makers and waiters. Local conditions in the building trades follow:

Atlanta — Residential construction taking up most of the building program. Enough building trades mechanics to meet all requirements. Unemployment chiefly among clerical workers and the unskilled.

Baltimore—Conditions normal in the building trades with enough work to absorb all available mechanics. Textiles and certain of the seasonal industries slow.

Birmingham—Over supply of common laborers. Construction is active and carpenters are in especially good demand. Slower production in iron and steel has caused some unemployment.

Boston—Common laborers are striking for 77½ to 80c. per hr. as against present rate of 50 to 60c. for non-union and 65 to 70c. per hr. for organized workers. Eight building crafts have signed agreements with employers to hold 1924 wage rates in force until Apr. 1, 1928. Open-shop policy has been announced by painting and decorating employers in reply to unions demand for advance of 15c per hr.

Cincinnati—Construction fairly active with plenty of building craftsmen available. Other industries slow.

Cleveland — Long standing controversy between carpenters and sheet metal workers over installation of metal trim, finally settled by decision of U. S. Circuit Court of Appeals, May 22, 1925. Builders may now use own discretion in employing men for metal trim work. Plumbers and steamfitters advanced 12½c. per hr.; electrician, 6¼c. during past month.

Dallas — Small surplus of common laborers and pile drivers. Building active. Some unemployment reported in other lines.

Denver—Activity noted in most of the industries, construction particularly. Slight shortage of bricklayers and plasterers reported, other trades sufficient to meet demand.

Detroit — Enough building trades craftsmen to meet demands of active residential and commercial building program. Slight unemployment noted in other industries.

Kansas City, Mo.—Public works and commercial building construction taking up most of the skilled and unskilled labor, although supply is fully equal to demand. Conditions in other industries improving.

Los Angeles — Plumbers advanced 12½c. per hr. over old rate. Unemployment reported in industries other than building.

Minneapolis — No labor troubles. Employment conditions good among skilled trades.

Montreal — Unemployment situation much improved. Surplus of common laborers; all non-union.

New Orleans—Dispute between subcontractors and bricklayers and plasterers still pending. The two trades demand wage increases. Present wage schedules in other trades will probably remain in force for another year, beginning June 1.

New York—Slight shortage of bricklayers and carpenters reported. Slump in building noted during first quarter has given way to increased activity during past two months. Labor supply in all lines is not greatly in excess of demand.

Philadelphia—There is an oversupply of carpenters and common laborers despite expansion in building opera-

Current Building Trades Wage Rates Per Hour

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1 12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.50@1.75	1.00@1.20	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00@1.50	.35@.87½	.75@1.25	.50@.75	.....	+.75@1.50	—.20@.40
Boston	1.25	1.10	1.10@1.30	.70@.75	1.10	1.10	+.50@.70
Cincinnati	1.50	1.25	1.25	.92½	1.25	1.25	—.40@.55
Chicago	1.50	1.50	1.50	1.25	1.50	1.50	.75@.87½
Cleveland	1.50	1.25	1.30	.87½	1.00	1.50	.87½
Dallas	1.50	1.00	1.00	.40@.75	.87½	1.00	.30@.50
Denver	1.62½	1.12½	1.12½@1.18¾	.81¼@.87½	1.00	1.15¾	.35@.55
Detroit	1.50	.70@1.00	.85@1.00	.90	.85@1.00	1.12½	—.50@.60
Kansas City	1.37½	1.12½	1.12½@1.25	.90	—1.12½	1.25	.40@.75
Los Angeles	+1.25	.87½	.75	.75	.75	.87½	.43¾
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	.90	.45@.65	.62½	.30@.35	.50	.65	.25@.30
New Orleans	1.25	.90	1.00	.65	.85	1.25	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00@1.12½	1.50	.50@.75
Philadelphia	1.50	1.12½	1.02½	1.12½	1.00	1.12½	.40@.45
Pittsburgh	1.55	1.37½	1.25@1.37½	1.00	.....	1.43¾	.70
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.50	1.50	.45@.77½
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.37½	1.12½	1.00@1.12½	1.00	1.00@1.12½	1.12½	.50@.62½

tions, chiefly residential. Other industries on the up-grade.

Pittsburgh—Structural iron workers recently advanced 6¼c. per hr. Residential building is predominant in the construction field with craftsmen plentiful enough and fully employed. Iron and steel operations slower with exception of tin plate, pipe and wire products mills.

St. Louis—Building trades mechanics in good demand; small surplus of unskilled common laborers. Other industries active.

San Francisco — Building in Bay region increasing in volume. Labor supply in excess of demand in industries other than construction. Shortage of bricklayers reported.

Seattle—Painters and sheet metal workers advanced 12½c. per hr. over old rate. Unemployment mostly among unskilled laborers. Improvement in demand for construction workers.

Monthly Prices of Construction Materials

Ups and Downs of the Market

COST of construction for the entire country is about one per cent below a month ago. May also dropped one per cent under the April level. This shows that while the trend is downward the descent is being accomplished by easy stages. Price firmness is noted in such items as light rails, railway supplies, steel scrap, sewer pipe, asphalt, tile, rope and piling. Weakness is apparent in pig iron, railroad ties, c.-i. pipe, lime, lumber, rivets, nails, steel sheets, water and sewage treatment chemicals.

Pig Iron—Current prices are below those of a month ago or one year ago. The volume of orders, mostly small tonnage lots, has increased during the past week. Reserve stocks continue to accumulate.

Railway Supplies — Some firmness reported in light rails at Pittsburgh and Birmingham mills during past month; general level below that of a year ago. White and red oak and sap pine-cypress ties are 10 to 15c. per tie under the May quotations at St. Louis. Creosoted and zinc treated ties are also lower. Standard spikes are firm as to price; the mill price of angle bars is higher; track bolts are down.

Pipe — The trend continues downward in cast-iron pipe. Increases in wrought-steel pipe discounts are reported, at warehouses, in a few scattered instances. Sewer pipe advanced, mostly in sizes 5 to 12-in., in Boston, Atlanta and Kansas City, Mo., during month; no declines were reported.

Road and Paving Materials—With an increase of 10 per cent in May paving contracts, over the month preceding, asphalt advanced in Boston, San Francisco, Philadelphia and St. Louis. A slight decline occurred in Atlanta. Some slight fluctuation reported in road oils. Paving stone, flagging and curbing prices show no recent changes. Wood blocks slightly higher in the West.

Sand, Gravel and Crushed Stone—No fluctuations developed during the past month in prices of aggregates in twenty cities reporting regularly to *Engineering News-Record*.

Lime and Cement — Lime dropped slightly in St. Louis; eighteen other cities reported no price changes for the month. Cement retained its customary price stability during May. Of thirty cities reporting monthly, slight changes occurred in only three.

Brick and Hollow Tile — Delivered price of common brick rose $1 to $2 per M since May 1 in New York City. This advance, however, is offset by declines of 50c. per M occuring at the same time in Boston and San Francisco. Hollow tile is higher than a month ago in Atlanta, Baltimore and Dallas; and slightly lower in Kansas City and St. Louis.

Structural Steel—Prices of the principal hot-rolled products have not changed perceptibly at mills and warehouses during the month just closed. The present range for plates and shapes is $1.90 to $2.10 per 100 lb., Pittsburgh, with reinforcing bars holding firmly at $2 per 100 lb. Of the three hot-rolled items, bars are in best demand, with considerable improvement noted in plate buying, particularly in the East. Shapes are weakest, although bookings of structural steel sales for April were the heaviest reported since Jan. 1.

Lumber—Production and demand for the first twenty-one weeks of this year are both ahead of last year to date. The trend in pine is downward in New York, St. Louis, Detroit, Kansas City and Atlanta. Fir is also lower in Kansas City while Denver reports advances in fir, hemlock and spruce. Lumber demand is most active in upper grades of flooring, finish, lath, special cutting, railroad material and timbers.

Iron and Steel Scrap — Situation in this material is firmer than a month ago, particularly in the New York district.

Miscellaneous Materials — Rope and piling (pine and steel-sheet) are firmer than a month ago. Price weakness is apparent in rivets, nails, steel sheets, water and sewage treatment chemicals.

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

	June 4	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25@2.75)	*$23.05*	$25.05
Northern Basic	*22.27*	24.00
Southern Ohio No. 2 (silicon 1.75@2.25)	*22.27*	24.00
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	27.37	28.00
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	*20.00@22.00*	22.00@23.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	*23.26*	24.25
Virginia No. 2 (silicon 2.25@2.75)	29.17	28.17
Basic	*22.26*	24.00
Gray Forge	*22.75*	24.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	*22.00*	24.50
No. 2 Foundry Southern (silicon 2.25@2.75)	*25.55*	27.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	*22.77*	25.77
Basic	*22.77*	25.77
Bessemer	*22.77*	26.77

SCRAP—The prices following are f.o.b., per gross ton paid to dealers and producers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	$14.00	*$14.00@$14.50**	$15@**$16**
Stove plate	11.00	*14.00@* 14.50*	*13@ 14*
No. 1 machinery cast	14.00	*17.50@ 18.00**	*16.50@*17.00
Machine shop turnings	9.00	*8.50@ 9.00*	*7@ 8*
Cast borings	10.00	*10.50@ 11.00*	15@ 16
Railroad malleable	13.00	*18.00@ 18.50*	18@ 19
Re-rolling rails	14.00	*17.50@* 18.00	*16.50@17.00*
Re-laying rails	20.00	*25.00@* 26.00	*21@22*
Heavy melting steel	12.00	15.50@ 16.00	.....

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	June 4	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	$46@49
Standard openhearth rails	43.00	43.00	43.00	43.00	48@52
Light rails, 8 to 10 lb.	**33@35**	38@**40**	**34@36**	36.00	
Light rails, 12 to 14 lb.	**33@35**	38@**40**	**34@36**	36.00	2.05@2.15*
Light rails, 25 to 45 lb.	**33@35**	40.00	**34@36**	38.00	1.95@2.10*
Re-rolled rails	**30@32**	37@38	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$2.00
Chicago, (creosoted) (zinc treated)	1.85	2.10
San Francisco, Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak, plain	*1.15*	*1.55*
St. Louis (creosoted) (zinc treated)	*1.55*	*1.75*
St. Louis, Red Oak, plain	*1.05*	*1.25*
St. Louis, Sap pine-cypress	*1.00*	*1.20*
Birmingham, White Oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh				San Francisco	Birmingham
	June 4	One Year Ago	Chicago	St. Louis		
Standard spikes, ½-in. and larger	$2.80	$2.90@3.00	$3.55	$3.65	$4.35	$2.90
Track bolts	3.90@*4.00*	3.75@4.00	4.55	*4.55*	5.85	3.90
Standard section angle bars	**2.80**	2.75	3.30	*3.40*	4.00	3.85

Pipe

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	53%	59½%	62%	49%
3½ to 6 in. lap welded	48%	57½%	59%	46%

	Galvanized			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	39%	48%	50½%	36%
3½ to 6 in. lap welded	35%	45%	47½%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 36% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham	Pittsburgh	New York	
			June 4	One Year Ago
4 in.	$52.20@54.20	*$51.20@52.20*	*$55.60@56.60*	$66.60@68.60
6 in. and over	48.20@50.20	47.20@48.20	*50.60@51.60*	61.60@63.60

	Chicago	St. Louis	San Francisco
4 in.	$50.70@52.26	$51.60	*$56.00*
6 in. and over	46.60@48.20	47.60	*52.00*

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

	New York					
Size, In.	June 4	One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$48.00	$45.00	$40.00	$45.00	.....	$73.00
4	50.00	55.00	40.00	56.00	$76.50	110.00
5	70.00	80.00	.....	80.00	97.75	118.00
6	92.00	105.00	70.00	100.00	127.50	150.00
8	160.00	170.00	170.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.081	$0.10	.....	.....	$0.12	.....
4	.....	.081	.10	$0.10	.....	.15	$0.15
5	.....	.1215	.135	.....	.....	.18	.18
6	$0.21	.1215	.135	.14	.....	.21	.21
8	.35	.189	.21	.225	.....	.30	.325
10	.52	.2835	.315	.315	.....	.42	.476
12	.66	.3645	.45	.405†	.....	.56	.612
15	1.14†	.486	.54	.675†	.....	.92	1.02
18	1.65†	.675	.75	.945†	.....	1.32	1.53
20	1.98*	.81	.90	1.26†	.....	.....	.....
22	2.65†	1.08	1.20	.....	.....	.....	1.564
24	2.97†	1.215	1.35	1.62†	.....	2.16	2.04
27	4.65†	2.405	2.665	2.45†	.....	3.00	3.34
30	5.16†	2.664	2.952	3.00†	.....	3.60	4.06
33	6.98†	3.60	3.96	3.55†	.....	.....	4.99
36	8.00†	4.10	4.51	3.95†	.....	.....	5.42

	3	5	8	12	24	36
Boston	$0.13	**$0.20**	$0.30	**$0.65**	$2.05†	$5.60†
Minneapolis	.....	.....	.25	.45	*1.50*	4.76†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.14	.....	.35	.72†	2.60†	.....
Los Angeles	.1625	.195	.275	.495	1.65	.....
New Orleans	.115*	.177*	.295	.5615	1.907	.....
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.11*	**.16½***	**.27½**	**.4675**	**1.7875**	.....
Montreal	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.105	.1575	.245	.4725	2.16†	5.6375†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	.15*	.21*	**.33½**	.52	.....	.....
Philadelphia	.12	.18	.28	.54	1.80	4.61

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

		June 4	One Year Ago
New York, 45% asphalt	(at terminal)	$0.065@$0.07	$0.053
New York, 65% asphalt	(at terminal)	.0675@.0725	.051
New York, binder	(at terminal)	.07 @ .075	.06
New York, flux	(at terminal)	.07 @ .075	.04
New York, liquid asphalt	(at terminal)	.07 @ .075	.048
St. Louis, 40@50% asphalt		*.049*	.048
St. Louis, 50@60% asphalt		*.0527*	.049
Birmingham, 55% asphalt		.0475	
Dallas, 45% asphalt		.0495	.0495
Dallas, 55% asphalt		.0455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		**13.50***	9.50*

* F.o.b. Olsum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$23.50*	$19.50
Boston (*Mexican*)	**22.00**	**17.50**
Chicago (*Trinidad*)	31.00	
San Francisco, *f.o.b. refinery*, Oleum, Cal.	**19.50**	**13.50**
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	
Minneapolis, *f.o.b. Twin Cities* (*Stanolind*)	27.60	21.60
St. Louis (*Mexican*)	**26.50**	**23.00**
Baltimore (*Mexican*)	23.50	19.50
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	*28.40*	*24.40*
Detroit (*Mexican*)	22.00	18.00
Cincinnati (*Kentucky Rock*)		11.65
Maurer, N. J. (*Bermudez*)	30.00	28.00
Maurer, N. J. (*Mexican*)	24.00	22.00
Philadelphia (*Mexican*)	**24.00**	**22.00**
Kansas City (*Texas*)	27.30	22.30
Los Angeles ("*D*" *grade, California*)	19.50	13.50†
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	20.00	17.00

*In drums. †f.o.b. El Segundo Refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$142.00 per M.
Chicago	About 4x8x4 dressed	per sq.yd.
	About 4x8x4 common	per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd.	130.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4	1.65 per sq.yd.
Kansas City	Granite	4.00 per sq.yd.
Philadelphia	Granite	3.00@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	24 per sq.ft.
	Queens, 5 ft. wide	26 per sq.ft.
	6x24-in. cross-walk	1.25 per lin.ft.
Chicago	18 in. wide	per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 88c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., $1.05 per lin.ft.; roundings, **$1.60.**

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd
New York	3	16	$2.51
New York	3½	16	2.82
Boston	3½	18	2.52½
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	2.40
St. Louis	4	16	2.70
Seattle	4	16	Off market
Minneapolis	3½	16	2.49
Atlanta	3½	16	**2.00**
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	
Cincinnati	3½	16	2.38
Kansas City	4	16	**4.00**
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. June 4	Gravel 1½ In. One Year Ago	Gravel ¾ In. June 4	Gravel ¾ In. One Year Ago	Sand June 4	Sand One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.00
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	2.75	2.00	2.75	2.00	2.75	2.00
St. Louis	1.45	1.60†	1.45	1.60†	1.18	1.35†
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	1.65*	1.85*	1.65*	1.85*	1.25	1.25
Cincinnati	1.40†	1.40†	1.40†	1.40†	1.35†	1.35†
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	1.50†	1.40†	1.50†	1.40†	1.00†	1.10†
New Orleans	2.60	3.00	2.60	3.00	1.75	1.25
Los Angeles	1.30†	2.15	1.30	2.20	1.10†	1.70
Atlanta	1.90†	2.00†	1.90†	2.00†	1.40†	1.40†
Detroit	2.02	2.05	2.02	1.75	1.62	1.35
Baltimore	1.40	1.40	1.60	1.60	0.70*†	0.70*†
Montreal	1.25†	1.25†	1.25†	1.50†	1.25†	1.25†
Birmingham	2.00	1.90†	2.00	2.05	1.45†	1.25†
Philadelphia	2.10	2.10	2.10	2.10	1.50	1.50
Kansas City (Joplin chats)	4.00		4.00		0.66	†0.66*†

New York—Grits, $1.75 per cu. yd., ready mixed, $1.85.
Los Angeles—Freight from quarry, 72c. per ton, and is included in above price.
* At pit. † Per ton.

CRUSHED STONE—Price for cargo or carload lots, f.o.b. city, is as follows per cu.yd.:

	1½ In. June 4	1½ In. One Year Ago	¾ In. June 4	¾ In. One Year Ago
New York	$1.75	$1.75	$1.85	$1.85
Chicago	2.75	2.00	2.75	2.00
St. Louis	1.83*	1.75*	1.83*	1.75*
Dallas	2.40	2.83	2.83	2.83
San Francisco	2.15	2.15	2.15	2.15
Boston	1.60*	1.45*	1.60*	1.45*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City	1.50	1.50	1.50	1.50
Denver	2.50	3.50	2.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2.00*	2.00*
Cincinnati	1.90*	1.90*	1.90*	1.90*
Los Angeles	1.50*		1.50*	
Detroit	1.50	1.75	1.50	1.75
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	1.80*	1.90*	1.90*
Philadelphia	2.10	2.10	2.10	2.10
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	2.00	2.00	2.00	2.00

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.25	$1.35	$2.00	$1.25
Steubenville District	1.25	1.30	2.00	1.30
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.			2.50	
Birmingham, Ala.	.90	1.15	2.05	.80
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.30	1.30	1.30	1.30
Eastern Pa. and Northern N. J.	1.25	1.25	2.50	1.25
Western Pennsylvania	1.25	1.25	2.50	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	
Toledo, Ohio	1.25	1.25	1.50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton—Finishing	Hydrated, per Ton—Common	Lump, per Barrel—Finishing	Lump, per Barrel—Common
New York	$18.20	$12.00@$13.10	$3.50*	$2.50@2.75*
Chicago	20.00	18.00		1.21†
St. Louis	*24.00*	*19.00*	12.50‡	*13.50‡*
Boston	20.00	14@15	3.75*	3.00*
Dallas	20.00			1.85†
Cincinnati	16.80	14.30		13.40‡
San Francisco		22.00		1.60†
Minneapolis	25.50	21.00 (white)	1.60@1.70†	1.35†
Denver	24.00			2.70†
Detroit	15.50	15.50	20.00‡	20.00‡
Seattle, *paper sacks*	24.00		2.80†	
Los Angeles		18.00		2.70†
Baltimore	24.25	17.85	2.55†	
Montreal		21.00		10.50‡
Atlanta	22.50	14.00	2.10†	1.45†
New Orleans	24.00	16.00	2.00†	2.00†
Philadelphia	23.00	16.00		
Kansas City	19.50	18.50	2.45*	2.10*
Birmingham	22.50	15.00	2.10†	1.75†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	June 4	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.35	1.80
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.50	2.60
St. Louis (Carney)	*2.30*	2.45
Birmingham (Magnolia) pozzolan cement	2.40	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	June 4	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.50@2.60
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	*2.50*	2.55	2.65
Chicago	2.20	2.20	2.20
Pittsburgh	2.19	2.19	2.19
Cleveland	2.39	2.39	2.39
Detroit	2.35	2.35	2.40
Indianapolis	2.41	2.41	2.41
Milwaukee	2.35	2.35	2.35
Duluth	2.19	2.19	2.19
Peoria	2.37	2.37	2.37
Cedar Rapids	2.44	2.44	2.40
Davenport	2.39	2.39	2.39
St. Louis	2.30	2.30	2.30
San Francisco	2.31	2.31	2.61
New Orleans	2.40	2.40	2.40
Minneapolis	2.42	2.42	2.42
Denver	2.84	2.84	2.84
Seattle	2.65	2.65	2.90
Dallas	2.05	2.05	2.05
Atlanta	**2.40**	2.30	2.35
Cincinnati	2.47	2.47	2.47
Los Angeles	2.80	2.80	3.00
Baltimore	2.90	2.90	2.50
Birmingham	2.40	2.40	2.65
Kansas City, Mo.	**2.60**	2.55	2.27
Montreal	1.80	1.80	2.25
Philadelphia	2.41	2.41	2.41
St. Paul	2.42	2.42	2.42
Toledo	2.40	2.40	2.45

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.05
Universal, Pa.	1.95	Leeds, Ala.	1.95
Steelton, Minn.	2.00	Hannibal, Mo.	2.05
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	2.05	Wyandotte, Mich.	2.10
Iola, Kan.	1.95	Alpena, Mich.	1.95
Mason City, Ia.	2.00	Richard City, Tenn.	2.05
La Salle, Ill.	2.05	Kingsport, Tenn.	2.05

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.97	$0.95	$1.39	$1.06	$1.13	$1.22
049	28	1.23	1.20	1.76	1.35	1.38	1.55
068	35	1.51	1.50	2.16	1.66	1.67	1.91
093	45	1.94	1.93	2.77	2.13	2.00	2.46
126	57	2.39	2.38	3.45	2.63	2.55	3.03
153	68	2.86	2.85	4.11	3.14	3.15	.....
180	78	3.28	3.28	5.70	3.60	3.47	.....
245	103	4.33	4.33	6.21	4.75	4.58	.....
287	119	5.00	5.00	7.19	5.50	5.26	6.35
336	138	5.80	5.80	8.35	6.37	6.11	.....
395	160	6.72	6.72	9.65	7.38	7.12	.....
PAVING							
036P	17	$0.74	$0.75	$1.06	$0.81	$0.76	.....
053P	24	1.04	1.05	1.50	1.14	1.07	.....
072P	31	1.32	1.32	1.90	1.45	1.39	.....
097P	40	1.70	1.70	2.45	1.87	1.90	.....
049R	24	1.04	1.04	.....	1.14	1.07	.....
067R	31	1.32	1.30	.....	1.45	1.39	.....
089R	40	1.70	1.70	.....	1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	St. Louis	San Francisco	Dallas
2.2	$19.00	$22.00	$21.00	$24.00	$23.50
2.5	20.50	23.00	23.00	26.00	25.00
3.0	23.50	26.00	27.00	30.00	28.50
3.4	25.00	28.00	29.00	33.00	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Warehouse, Uncut: Birmingham	New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2.00	$2.25	$3.24	$3.00	$3.15	$3.38	$3.35
⅝	2.10	2.35	3.34	3.10	3.25	3.43	3.45
¾	2.20	2.45	3.44	3.20	3.35	3.48	3.55
⅞	2.40	2.65	3.64	3.40	3.55	3.63	3.75
1	3.00	3.25	4.24	4.00	4.15	3.78	4.35

* For size and cutting extras, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ and larger	$2.55*	$3.08	⅝	$2.95*	$3.30
¾ in.	2.65*	3.13	⅞	3.55*	3.48
1	2.75*	3.18		.....	.....

* Warehouse shipments.

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: June 4	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$18.00@19.00	$17.00	$23.65	$45.00	$51.00
New York (at dock)	15.00@16.00	15.00	20.00	.....	.....
Chicago	12.00	12.00	11.00	48.00	.....
St. Louis, salmon (del.)	16.00	16.00	16@18	37.50	40.00
Denver, salmon	12.00	12.00	12.00	.....	.....
Dallas	12.10	12.10	14.10	35.00	.....
San Francisco	15.00	15.50	15.50	.....	.....
Los Angeles	13.00	13.00	14.50	(not used)	
Boston (del.)	17.50	18.00	22.50	45.00	50.00
Minneapolis (del.)	13.50@13.60	13.50@13.60	14.00	.....	.....
Kansas City	14.50	14.50	16.50	(no market)	
Seattle	15.00	15.00	15.00	.....	42.50
Cincinnati	17.00	17.00	17.00	40.00	45.00
Montreal	17.50	17.50	17.50	100.00†	68.00
Detroit (del.)	17.50	17.50	17.50	37.50	40.50
Baltimore	18.00	18.00	18.00	40.00	45.00
Atlanta	10.50	10.50	12.00	40.00	.....
New Orleans	15.00	15.00	19.00	.....	.....
Birmingham	12.50	12.50	12.50	40.00	45.00
Philadelphia	19.00	19.00	19.00	40.00	50.00
Pittsburgh (del.)	16.00	16.00	16.00	.....	.....
Cleveland	14.00	14.00	16.00	.....	.....

*For paving blocks 3½x8½x3 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: June 4 on Trucks*†	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	$0.1162	$0.1162	$0.06	$0.1325	$0.078	$0.108	.....
6x12x12	.1743	.1743	.0825	.....	.102	.156	.....
8x12x12	.2179	.2179	.1125	.25	.14	.244	.....
10x12x12	.....	.....	.14	.....	.17	.....	$0.252
12x12x12	.....	.....	.18	.....	.198	.....	.312

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	$0.09	$0.18	.....
Minneapolis (f.o.b. cars)	.0636	.106	$0.189
Minneapolis (delivered)	.07	.116	.205
Cincinnati	.07485	.13745	.....
Kansas City	.085	.135	.....
Denver	.085	.155	.188
Seattle (delivered)	.10	.20	.30
Los Angeles	.085	.172	.....
New Orleans	.13	.30	.....
Detroit (delivered)	.0775	.1743	.....
Montreal	.12	.225	.30
Baltimore	.126	.21	.....
Atlanta	.0888	.1666	.....
Dallas	.10	.19	.275
Birmingham	.11	.1824	.22
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.07	.13	.....

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.90@2.10	$2.05	$3.34	$4.15	$3.25	$3.10	$3.30
Channels, 3 to 15 in.	1.90@2.10	2.10	3.34	4.15	3.25	3.10	3.30
Angles, 3 to 16 in., ¼ in. thick	1.90@2.10	2.10	3.34	4.15	3.25	3.10	3.30
Tees, 3 in. and larger	1.90@2.10	2.10	3.34	4.15	3.35	3.10	3.30
Plates, ¼ in. thick and heavier	1.90@2.10	2.00	3.34	4.15	3.25	3.10	3.30

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York June 4	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.40@2.60	$4.50	$4.00	$3.50	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.	$2.90	$4.60	$4.10	$3.70	$4.20	$5.20	$5.00
⅝ and ¾	3.05	4.75	4.26	3.80	4.45	5.35	5.15
⅞ and 1	3.30	5.00	4.50	4.05	4.60	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.75	$2.85	$3.25	$3.85	$4.28	$3.33	4.95
Cut	2.90	2.90	.....	5.25	5.00	3.58	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	Black	Seattle Black
½	$8.00	$6.00	$7.75
⅝	7.30	5.30	5.65
¾	7.15	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.25.

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.75 per roll to consumers in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $7.56 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $5.80 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to consumers in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	$84.38
Tar pitch (in 400-lb. bbl.), per 100 lb.	1.86
Asphalt roofing (in barrels), per ton, f.o.b. plant	38.81
Asphalt felt (light), per ton, f.o.b. plant	87.75
Asphalt felt (heavy), per ton, f.o.b. plant	87.75

Delivered in Metropolitan Dist., $2.00 additional.

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 82 per cent; "A," 86 per cent; "B," 88 per cent. Double thickness "AA," 82 per cent; "A," 85 per cent; "B," 88 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.40@2.50	$3.90	$3.80	$4.20	$3.89
No. 12	2.45@2.55	3.95	3.85	4.25	3.94
No. 14	2.50@2.60	4.00	3.95	4.30	3.99
No. 16	2.60@2.70	4.10	4.15	4.40	4.09
Black					
*Nos. 17 to 21	2.95@3.20	4.60	4.30	5.05	$4.40
*Nos. 22 to 24	3.00@3.25	4.65	4.35	5.10	4.45
*No. 26	3.05@3.30	4.70	4.40	5.15	4.50
*No. 28	3.15@3.40	4.80	4.50	5.25	4.60
Galvanized					
No. 10 and 11	3.30@3.50	4.80	4.50	5.25	4.60
No. 12 to 14	3.40@3.60	4.90	4.60	5.35	4.70
No. 16	3.55@3.75	.....	.....	.....	4.85
Nos. 17 to 21	3.70@3.90	5.20	4.90	5.65	5.00
Nos. 22 to 24	3.85@4.05	5.35	5.05	5.80	5.15
*Nos. 25 and 26	4.00@4.20	5.50	5.20	5.95	5.30
*No. 28	4.30@4.50	5.80	5.50	6.25	5.60

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: June 4	One Year Ago	Chicago: June 4	One Year Ago
Raw in barrels (5 bbl. lots)	$1.09	$0.98	$1.23	$0.94

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	June 4	1 Yr. Ago	June 4	1 Yr. Ago
Red	$15.75	$15.00	$17.25	$16.50
White	15.75	15.00	15.75	15.00

Lumber

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
4x14	30.00	30.00	32.00	34.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00	$30.00	$32.00
6x14	34.00	36.00	38.00
8x10	28.00	30.00	32.00
8x14	34.00	36.00	38.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		St. Louis	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	*$45.00*	*$46.00*	$39.00	$41.00
3x10 to 10x10	*49.00*	*50.00*	43.00	45.00
3x12 to 12x12	*54.00*	*55.00*	48.00	50.00
3x14 to 14x14	*62.00*	*63.00*	55.00	57.00
3x16 to 16x16	*70.00*	*71.00*	62.00	64.00
3x18 to 18x18	.....	.....	67.00	69.00
4x20 to 20x20	.....	.....	77.00	79.00

* Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under; for sizes over 12x12 add $2; for merchantable add $2 to sizes 10x10 and under.

Other Cities	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$51.00	$48.00†	$50.00	$50.00	$61.00	$58.00†
Seattle	.....	29.50	.....	.....	.....	23.00
New Orleans	42.00	.....	.....	.....	32.00	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	58.00	.....	.....	60.00	65.00
Los Angeles	.....	37.00	.....	.....	.....	38.00
Denver	.....	**35.75**	**35.75**	**35.75**	.....	**36.25**
Minneapolis	43.00	39.75	36.00	.....	44.50	39.75
Atlanta	*31.00*	.....	.....	.....	*34.00*	.....
Dallas	52.25	.....	.....	.....	56.00	.....
Kansas City	*41.00*	40.75	.....	.....	*52.00*	41.75
Birmingham	32.00	.....	.....	.....	34.00	.....
Philadelphia	56.00	32.00	37.00	40.00	64.00	32.00
Detroit	*46.25*	51.75	.....	.....	*56.25*	51.75
St. Louis	*39.00*	.....	.....	.....	48.00	.....

	1-In. Rough, 10 In. and Under x 16 Ft.			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$45.00	$42.00†	$44.00	$50.00	$48.00†
Seattle	.....	25.00	.....	.....	29.00
New Orleans	80.00	.....	.....	40.00	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	70.00	79.00	75.00	38.00	85.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	32.00	.....	.....	**95.00**
Denver	.....	*34.00*	34.75	.....	**32.75**
Minneapolis	43.00	37.75	35.75	38.00	35.25
Atlanta	*18.00*	.....	.....	*28.00*	.....
Dallas	52.25	.....	.....	55.73	.....
Kansas City	*49.25*	*42.25*	.....	*39.75*	*48.75*
Birmingham	19.00	.....	.....	.....	.....
Philadelphia	32.00	31.00	36.00	54.00	32.00
Detroit	*45.25*	40.50	.....	*48.50*	41.25
St. Louis	**43.00**	.....	.....	*29.00*	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $2 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

June 4	One Month Ago	One Year Ago
$2.25@2.30	$2.15@2.25	$2.35@2.40

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft.; ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.18@.22	New Orleans	$0.26½
New York	.27	Los Angeles	.24½
Chicago	.21½	Seattle	.17
Minneapolis	.28½	St. Louis	.26½
San Francisco	.26	Montreal	.16
Atlanta	.30	Detroit	.19
Denver	.30	Baltimore	.18
Cincinnati	.21	Kansas City	.21½
Dallas	.28	Birmingham	.23@.25
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.225	.25
Kansas City	.2025	.2225
Seattle	.165	.19
Chicago	.1525	.1775
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1875	.2125
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.195	.235
Birmingham	.23	.255
New Orleans	.233	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. works:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.45
Sulphate of copper, in bbl., per 100 lb.	4.65@4.85
Soda ash, 58%, in bags, per 100 lb.	*1.25*
Chlorine, liquid, tanks, per lb.	.04
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	*1.80@2.00*

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.15*
Cincinnati	.29	Philadelphia	.32
Cleveland	.19	St. Louis	.43
Denver	1.15*	St. Paul	.60

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.